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NOTES ON SOME AMPHIBIANS AND REPTILES FROM THE SOUTHEASTERN STATES WITH A DESCRIPTION OF A NEW SALAMANDER FROM NORTH CAROLINA

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Plates 23–26

This paper puts on record the results of a collecting trip, in October 1926, to the mountains of eastern Tennessee, western North Carolina and northern South Carolina and Georgia. On my first trip to the Blue Ridge mountains, in October 1923, collections were made on Mt. Mitchell, Grandfather Mt., the foothills near Black Mt. and the lower slopes of Mt. Pisgah. The 1926 itinerary included Frying Pan Mt., Big Bald Mt., Mt. Pisgah to the summit and Wayah Bald in North Carolina and Mt. LeConte of the Great Smokies in Tennessee. Short visits were made to various other localities in South Carolina and Georgia. I have also included some records of specimens secured at various times from friends and correspondents. Particular mention may be made of the series of salamanders collected by Mr. K. F. Chamberlain of the New York State Museum, in Virginia and Tennessee. I would also acknowledge my indebtedness to Professor C. R. Crosby and Doctor Forest M. Blodgett of Cornell University with whom the trip was made and who contributed many specimens.

The drawings were made by Mr. Walter J. Schoonmaker of the New York State Museum; the photographs of living specimens by Mr. E. J. Stein of the State Museum and the writer.

The mountains of western North Carolina have received considerable

attention from herpetrologists, collections having been made and reported on by Brimley ('12, '26, '27), Dunn ('17, '20), Breder and Breder ('23), Pope ('24), Noble ('27) and the writer ('24). Much remains to be accomplished, however, particularly in the study of life histories, habits and habitat relationships. It should be emphasized that the habits and habitat preferences of the various species can never be determined fully until studies are carried on throughout the year over a considerable number of years. Observations covering a period of a few days or weeks are of value for the particular time and place but furnish slender grounds for conclusions of a general nature. In October 1923 many localities were visited during a protracted drouth, the streams being shrunken to half their normal flow. In these the salamander population was concentrated, many species being thrown together that usually, perhaps, would have occupied more distinct habitats.

Dunn ('26, p. 17) writing of *Desmognathus phoca* and *D. quadra-maculatus* says: "Instead of being, like *quadra-maculatus*, an animal of the streams, it (*phoca*) is a creature of the banks of smaller brooks." My own observations, in the main, confirm those made by Dunn but neither species is strictly confined to one type of stream or the other. In one small mountain brook on the southwest side of Grandfather Mt., N. C., both species were found and in addition *Leurognathus marmorata*. Where the stream is of considerable size, there is *some* evidence of segregation, the majority of specimens of *phoca* being found along the margins, *quadra-maculatus* beneath stones in swifter waters and *marmorata* in the pools.

Noble ('27, p. 2) makes clear distinctions between stream types and remarks concerning these species: "I have never found an adult *quadra-maculatus* in a muddy trickle or an adult *phoca* in a rocky stream, but half grown individuals occur in both types of habitats." The Grandfather Mt. stream mentioned above fulfills all the requirements of a muddy trickle, being moss grown, leaf choked and mud-bottomed. The water, however, was clear and beneath the moss and rubbish I collected larvae, half grown individuals and adults of both species. These observations do not discredit the statements made by others; they do emphasize the necessity of being cautious when making general statements based on limited field experience.

In discussing D. *quadra-maculatus* in an earlier paper ('24, p. 94) I wrote: "In life it may be associated with the smaller *Desmognathus phoca* and *D. ochrophaeus carolinensis* although the latter species is also found in situations that do not prove acceptable to *D. quadra-macula-*

tus." I would modify this statement only by including *D. fuscus fuscus, Gyrinophilus danielsi* and *Eurycea bislineata wilderae* among the species that may be associated with *quadra-maculatus* in the streams or along their margins.

In discussing the habitat preferences of salamanders it is necessary to consider not only temporary changes in habitat associated with breeding habits or transformation but seasonal changes and those enforced by periods of drouth and excessive rainfall. Furthermore, the habits and habitat preferences of certain widely distributed species vary somewhat in different parts of the range. Certainly not enough work has been done in the Blue Ridge mountains to justify final conclusions.

The definite collecting localities listed below are those which proved exceptionally productive of salamanders and are given in the hope that they may be of service to others who may visit the region.

Mt. LeConte of the Great Smokies, may be reached conveniently from Gatlinburg, Tennessee. We collected on the mountain itself and in the vicinity of Gatlinburg from October 7th to the 11th. From Gatlinburg two well marked trails lead to the summit of LeConte from which an endless vista of forest and mountain spreads away on all sides. The foot trail by way of the Cherokee Orchards follows, in general, the course of Mill Creek. In this stream and along the margins, *Desmognathus quadra-maculatus* (Holbrook) is the most abundant salamander and outnumbers all the other species together. *Desmognathus fuscus fuscus* (Raf.), *D. fuscus carolinensis* Dunn and *D. phoca* (Matthes) occur sparingly. Beneath stones at the stream margin were a few individuals of *Eurycea bislineata wilderae* Dunn. Under stones and logs bordering the trail through the forest of spruce and poplar, *Plethodon jordani Blatchley* and *Plethodon glutinosus* (Green) were found. Near the summit of Mt. LeConte, in the springs at the source of Roaring Fork, *Gyrinophilus danielsi* (Blatchley) was abundant and associated with *Desmognathus quadra-maculatus* (Holbrook). Almost at the extreme summit of the mountain and a considerable distance from the nearest water several large specimens of *Eurycea bislineata wilderae* Dunn, were found under logs and stones or buried deeply beneath the thick ground covering of moss and leaf mold.

On October 12th we reached Frying Pan Gap near Big Pisgah, N. C. and camped for the night in the rain. The springs and streams nearby furnished a few specimens of *Gyrinophilus danielsi, Desmognathus quadra-maculatus, D. fuscus carolinensis* and *Eurycea bislineata wilderae.*

The forests of oak, chestnut, *Cornus* and *Rhododendron* covering the slopes of Frying Pan Mt. above camp yielded *Plethodon metcalfi* Brimley in considerable numbers.

The trail up Big Pisgah from the "Lodge" to the summit passes through forests of oak and chestnut with an undergrowth of *Rhododendron*. Balsam and spruce occur very sparingly. Under logs and stones in the denser parts *Plethodon metcalfi* is the conspicuous salamander. In the damper areas and along streams *Desmognathus fuscus carolinensis* occurs.

From Mt. Pisgah our way led to the Nantahalas which we reached on the night of October 15th and camped by the side of the road at the base of the eastern slope. On the morning of the 16th, collecting on foot up the road to the Pass (Wayah or Nantahala) a few specimens of *Plethodon shermani* Stejneger were discovered under logs and slabs of wood or rarely beneath loose flakes of rock. *Desmognathus fuscus carolinensis* was fairly abundant and beneath a log far away from water, a single specimen of *Gyrinophilus danielsi* was found.

The most conspicuous animal of the Nantahalas is the razorback hog, pastured here by hundreds and ranging from base to the extreme summit. Only on the most precipitous slopes is it possible to find a place where they have not completely rooted out the smaller undergrowth and turned over the leaf mold. Logs and stones are thrust aside in the search for acorns and chestnuts and salamanders and other small creatures are taken when found. Streams and springs are gutted and roiled in the search for crayfish and salamanders. The collector interested in the fauna of the leaf mold finds that the hogs have been there before him mixing the leaves with the soil beneath and exposing all to the air to become dry as tinder. It is to be regretted that this scenic wonderland and a part of the National Forest is allowed to develop into a hog wallow.

The sparsely wooded slopes above the village of Tallulah Falls and the tree covered side of the Tallulah gorge itself were searched for specimens of *Aneides aeneus* and a single specimen secured.

Order CAUDATA

Family SALAMANDRIDAE

Triturus viridescens viridescens (Raf.)

Tennessee: Crabtree, July 9, 1927, 4 ads. K. F. Chamberlain, coll.

Family AMBYSTOMIDAE

Ambystoma opacum (Gravenhorst)

Plate 23, figure 4

Seventeen specimens collected under logs and bark in a branch of the Congaree River swamp are remarkably uniform in size and average only 69.1 mm. in length. The shortest and longest specimens are 55 and 79 mm. long respectively but fourteen of the seventeen specimens vary only from 65 to 75 mm.

South Carolina: Congaree River swamp west of Sumter, Oct. 20, 1926, 17 specimens.

Virginia: Nottoway River swamp 8 miles south of Franklin, Oct. 26, 1926, 1 ♂, 1 yg.

Ambystoma mabeei nov. sp.

Plate 23, figures 1 and 2

Type: U. S. Nat. Mus. No. 75058, collected by W. B. Mabee in the low grounds of the Black River near Dunn, N. C., May 12, 1923.

Mr. C. S. Brimley has mentioned this specimen (Copeia, No. 162, p. 10, 1927) under the name *Ambystoma microstomum* and described the color in life as brown above with lighter spots on the sides.

Body short and stout; head small, narrow; snout short and bluntly rounded. There are thirteen costal grooves if two that run together in the groin and one in the axilla are considered; two intercostal spaces between the appressed limbs; toes four-five; plantar and palmar tubercles present but not well developed; gular fold well developed.

The color in alcohol is uniform slate gray above, slightly lighter beneath and with only an indication of the lateral pale spots which were present in life.

The tail is thick and glandular and marked with about nine impressed vertical lines; there is an indistinct median dorsal line extending from a point above the fore legs to one above the vent and a slight ventral line of about the same extent. The dorsal surface of the head and trunk is smooth and shining. The teeth are in a transverse series interrupted behind the inner nares and extending somewhat outside them; middle line of teeth nearly straight and entire, the outer series set at an angle; tongue oval and provided with a median groove, the plicae meeting it obliquely. Total length 100 mm; tail from posterior end of vent 40 mm.

This species is obviously related to the group which includes *A. jeffersonianum*, *A. opacum* and *A. maculatum*. There is a superficial resemblance to some specimens of *A. texanum* (*microstomum*) (particularly old and faded individuals), but constant difference in number of costal grooves, the arrangement and number of the teeth and in the shape and proportions of the body. The body proportions are more nearly those of *A. opacum* from which it differs strikingly in color, in the number of costal grooves (11 or 12 in *A. opacum* and 13 in *A. mabeei*), in the character of the tongue which has a definite median groove, and in the size and shape of the head. To a less degree, the teeth also differ from those of *A. opacum*.

Compared with a specimen of exactly the same length, the differences in proportions are immediately evident and may be summarized briefly in tabular form:

	HEAD		TRUNK	TAIL		
	Length	Width	Distance between legs	Length	Width	Depth
	mm.	mm.	mm.	mm.	mm.	mm.
opacum	15	12	27	40	6	8
mabeei	13	11	32	40	8.5	10

The tail of *A. mabeei* has a depth almost uniform to the tip which is abruptly pointed. In *A. opacum* the tail gradually tapers. *Ambystoma talpoideum*, which is uniformly colored in preservative, differs in having fewer costal grooves, a much larger head, and tongue without a median groove.

The mouth parts of several species with which *A. mabeei* has been compared in the preceding paragraph are shown in detail in the appended figures (pl. 23, figs. 3–5).

A larva approaching transformation at a length of 63 mm. taken by Mr. C. S. Brimley at Andrews, N. C., May 1908, may be this species. It is uniform dull brown above, lighter below and with a series of small light spots on the sides between the legs. The costal grooves are 13 as in the Dunn, N. C., specimen and the plantar tubercles are present though not well developed.

I am indebted to Mr. Brimley for the privilege of describing this species.

Family PLETHODONTIDAE

Plethodon cinereus (Green)

North Carolina: Andrews, Oct. 17, 1926, 2 ads.

Plethodon glutinosus (Green)

North Carolina: Big Bald Mt., Oct. 13, 1926, 1 ad.; Andrews, Oct. 17, 1926, 2 ♂, 1 ♀.

Tennessee: Mt. LeConte, Mill Creek, 2500–3000 feet elev., Oct. 7, 1926, 2 ads.; Elkmont, Laurel Creek, Oct. 8, 1926, 1 ad.

Georgia: Tallulah Falls, Oct. 18, 1926, 3 ads; Dick's Creek Gap, on line between Rabun and Towns counties, Oct. 18, 1926, 1 ♂, 1 yg.

Virginia: Buffalo Creek 6 miles south of Lexington, July 5, 1927, 1 ad., K. F. Chamberlain, coll.

Mississippi: Clinton, May 1926, 8 ads., J. W. Bailey, coll.

The Mississippi specimens are characterized by strong spotting above and the fusion of the spots on the lower sides to form conspicuous bands, not complete, but much more so than in northern specimens. The spots on some are continued to the tip of the tail and in every specimen there is a lack of the dull brown color of the distal third of the tail which is characteristic of specimens from the north.

Plethodon jordani Blatchley

Plate 24, figure 9

This species did not seem to be particularly abundant on Mt. LeConte at the time of our visit. The smaller specimens were usually taken by sifting leaf mold and the larger individuals by turning stones and logs along the Mill Creek trail. The first specimens were found at an altitude of about 2500 feet. Above the falls *P. jordani* runs up to well over 5000 feet.

The smaller specimens varied in length from 29 mm. (tip of tail lost) to 55 mm. and the larger from 81 to 92 mm.

The color of the cheek patch varies from light pink to bright red in different individuals and some difference in color may be noted in the same individual if kept under observation for a few weeks.

Tennessee: Mt. LeConte, Mill Creek, 2500 to 3500 feet alt., Oct. 7, 1926, 3 young in leaf mold and under logs; Mill Creek above falls, Oct. 9, 1926, 3 young and 1 adult; Mill Creek below falls, Oct. 9, 1926, 3 adults.

Plethodon metcalfi Brimley

Plate 24, figure 7

This species is everywhere abundant at higher altitudes on Big Pisgah, Big Bald, and Frying Pan Mt. in western North Carolina. Under logs and stones imbedded in the thick leaf mold of the forests covering Frying Pan Mt., it is the dominant species. The woods here are chiefly of oak and chestnut with an undergrowth of *Cornus* and *Rhododendron*. Specimens appeared to be more abundant in the open, glade-like areas and along the trails than in the dense tangles of *Rhododendron*. On Mt. Pisgah and Big Bald Mt. we found no specimens above the limit of large tree growth.

North Carolina: Frying Pan Mt., Oct. 13, 1926, 20 specimens of both sexes, the larger individuals varying in length from 70 to 124 mm. and the smaller from 49 to 59 mm. The largest specimen taken here was a female 124 mm. long. In this the tail measured 62 mm. from posterior end of vent to tip. Three males measured respectively, 100, 106 and 123 mm. with corresponding tail measurements of 53, 52 and 67 mm.; Big Bald Mt., Oct. 13, 1926, 7 specimens; Mt. Pisgah, Oct. 14, 1926 (Lodge to summit) 17 specimens, the largest, a female, 135 mm. long with a tail length of 70 mm.; east fork of the Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 2 specimens.

Plethodon shermani Stejneger

Plate 24, figure 8

On the east side of Wayah Gap, the greater number of specimens were found in the shelter of logs and old planks, only a few beneath stones. The first specimens were secured at the site of an abandoned road camp at an altitutde of about 3,000 feet; widely scattered specimens were found thereafter until an altitude of about 5000 feet was reached.

The amount of red on the legs varies considerably. In one specimen the red was lacking except for a few minute flecks.

North Carolina: East side of Wayah Gap, Oct. 16, 1926, 15 specimens. In 13 of the 15 specimens the length varied from 90 to 149 mm.; the two smaller specimens measured 45 and 59 mm. respectively; Wayah Gap, Oct. 16, 1926, altitude 4100 feet, 3 specimens from beneath a large log; Wayah Gap to summit of Wayah Bald, Oct. 16, 1926, 1 adult 116 mm. long. Only a single specimen was found on the higher

slopes of Wayah Bald. The scarcity may have been due to the extremely dry condition of the forest floor combined with the activities of the razor-back hogs; west side Wayah Gap, Oct. 16, 1926, 6 specimens collected from beneath logs and stones in a *Rhododendron* thicket bordering a little stream near the base of the mountain about two miles east of Aquone, N. C.

Stereochilus marginatus (Hallowell)

A single specimen was raked out of a small pool at the edge of a swamp bordering the State highway near Whitakers, N. C. It was taken in company with a number of specimens of *Desmognathus fuscus fuscus* but was not recognized until the material was examined in the laboratory.

The pool, a shallow depression at the end of a road culvert, was filled with rotting leaves and a few growing plants and there was little indication of a current.

North Carolina: Whitakers, Oct. 25, 1926, 1 adult 83 mm. long; tail 34 mm.; altitude about 116 feet.

Gyrinophilus danielsi (Blatchley)

Plate 26, figure 14

This species reaches its best development at high altitudes. In such situations it is not only more abundant but attains a larger size and is more strikingly marked. Specimens from near the summit at Mt. LeConte, Tenn., are sparsely spotted above on a ground color that approaches that of *Pseudotriton montanus*.

North Carolina: East side of Wayah (Nantahala) Gap, Oct. 16, 1926, 1 adult beneath a log at the side of the road; Frying Pan Mt., Oct. 13, 1926, 1 adult; east fork of the Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 1 adult, 115 mm. long with a specimen of *Plethodon metcalfi* 82 mm. long in the stomach, a fragment of another salamander and a large tipulid larva; between Swain and Emma, Oct. 15, 1926, 1 larva, 110 mm. long.

Tennessee: Mt. LeConte (near summit) Oct. 10, 1926, 7 adults, 2 larvae; Mill Creek, Mt. LeConte (below falls), 1 larva, 55 mm. long; Cave near Three Springs about 2 miles north of Russellville, 1926, 1 adult, 135 mm. long but with tip of tail lost. J. D. Ives, coll.

The Mt. LeConte specimens were taken in a spring run near the summit of the mountain at an altitude of about 6400 feet. The two

larger specimens in the series were females, one of which measured 165 mm. in length and contained mature eggs in the ovaries. A second female measured 154 mm. in length and two males were 130 and 135 mm. respectively.

The specimen from the cave near Three Springs was taken about 800 feet from the entrance, in total darkness. It is pale in color with poorly defined spots.

Pseudotriton ruber schencki (Brimley)

Plate 26, figure 16

Only two specimens were secured. The North Carolina specimen is apparently an adult with the black chin and other characters of the subspecies but with the dorsal spots tending to fuse.

North Carolina: Wilmot, Oct. 15, 1926, 1 adult.

Tennessee: Juncture of Rough Creek and Little River near Elkmont, Oct. 8, 1926, 1 small specimen 85 mm. long. Under moss covering the gravelly bed of a small trickle.

Eurycea bislineata bislineata Green

North Carolina: Weldon, near Jackson, Oct. 26, 1926, 1 adult, 5 larvae.

Tennessee: Rough Creek near Elkmont, Oct. 8, 1926, 1 adult. The Elkmont specimen is marked exactly like many specimens from New York and New England. At the same time and place specimens having all the characters of the subspecies *wilderae* were taken.

Eurycea bislineata wilderae Dunn

Plate 24, figure 6

Mt. LeConte specimens average considerably larger than those recorded by Dunn (1926, p. 312). Dunn's largest specimen, a male, measured 93 mm., his largest female 90 mm. Fifteen males from Mt. LeConte have an average length of 94.6 mm. with extremes of 86 and 110 mm. Five females average 95 mm. in length, the largest, 106 mm. The color pattern is striking and while it is essentially the same as in specimens from Mt. Mitchell, N. C., it appears to be more conspicuously developed. The dark band on the sides is often broad and may continue unbroken to the tip of the tail. The dorsal markings are ex-

tremely variable. Between the lateral dark bands the back may be almost immaculate or finely specked. In other specimens a single broken, mid-dorsal line is present. In still others the spots are of large size and scattered irregularly over the surface. Below the lateral bands the sides may be strongly mottled with black and yellow (in several old females), or lightly flecked.

North Carolina: East side Wayah (Nantahala) Gap, Oct. 16, 1926, 2 specimens, one a female with well developed eggs in the ovaries; Wayah Gap, Oct. 16, 1926, alt. 4100 feet, 1 small specimen; west side Wayah Gap, Oct. 16, 1926, 2 adults; Frying Pan Mt., Oct. 13, 1926, 1 ♀ with large eggs in ovaries.

Tennessee: Mt. LeConte (Mill Creek, 2500 to 3500 feet elevation) Oct. 7, 1926, 5 ♂, 2 ♀, 2 yg. Two of the five males were without cirri; Mt. LeConte (near summit, about 6400 feet elevation), Oct. 10, 1926, 11 ♂, 2 ♀, 4 yg. and 5 larvae; Mt. LeConte, Mill Creek below falls, Oct. 9, 1926, 1 ♂, 1 ♀, 3 recently transformed and 2 larvae; Mt. LeConte, Roaring Fork, Oct. 10, 1926, 3 ♀; Rough Creek near Elkmont, Oct. 8, 1926, 1 ♂, 6 larvae.

Eurycea gutto-lineata (Holbrook)

Louisiana: Baton Rouge, Nov. 27, 1926, 1 adult, C. A. Brown, coll.

Eurycea lucifuga Rafinesque

Tennessee: Cave near Three Springs, 1926, 1 adult, J. D. Ives, coll. Taken near entrance of cave in twilight zone; Jefferson City, April 18, 1927, 1 adult, J. D. Ives, coll.

Aneides aeneus (Cope and Packard)

Plate 25, figures 10–12

A single specimen was taken Oct. 18, 1926 at Tallulah Falls, Ga. where several years ago the species was collected by Dr. J. Chester Bradley of Cornell University. Unfortunately, at the time of our visit, there had been no rain for several weeks and the woods were exceedingly dry. Like many other supposedly rare salamanders, this species will be found in abundance if search is made earlier in the season in suitable situations. I have specimens from Kentucky without definite locality records but possibly from Pine Mt., Harlan County, where the species is abundant.

The colors and pattern of this species have been imperfectly described. In life the ground color of the back and upper sides of a typically marked specimen is black with many irregular, greenish-yellow lichen-like markings. The legs are lighter with yellow predominating in small specimens. The belly and under surfaces of the legs light yellow. The toe disks are well developed and enable the salamander to run with surprising agility on vertical surfaces or even in an inverted position. The 107 mm. specimen collected by Mr. J. O. Pepper on Mt. Pinnacle, S. C., at an altitude of about 2000 feet was found in damp woods on the trunk of a tree about three or four feet from the ground. (See Brimley, Copeia, No. 162, 1927, p. 10.) During the dry period such as experienced at Tallulah Falls, Ga., no specimens were found exposed on the trunks of trees. The single specimen was hiding beneath a piece of bark lying on the surface of a rock two or three feet above the ground in very dry open woods.

The species is extremely agile and lizard-like in its movements and can leap several times its own length. In captivity it feeds well on fruit flies, capturing them with swift snapping movements.

Desmognathus fuscus fuscus (Raf.)

Typically marked specimens were fairly abundant at high altitudes on Mt. LeConte, Tennessee. Tallulah Falls, Georgia, specimens are considerably smaller, more slender and in some respects approach *D. fuscus carolinensis*. The widest departure from normal is found in a small series from Demorest, Georgia. In these the back and upper sides are very dark and the lower sides strongly mottled, black and yellowish-white. Lighter markings are also present on the dorsal tail keel and conspicuously on the snout and fore part of the head. The anterior half of the throat is light but back of this the entire venter is either uniform dark, much as in *Desmognathus quadra-maculatus*, or strongly mottled.

North Carolina: Whitakers, Oct. 25, 1926, 7 ads., 1 yg.; east fork of the Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 3 ads., 3 yg.

Tennessee: Mt. LeConte, Oct. 10, 1926 (altitude, 6400 feet) 10 adults varying in length from 78 to 101 mm.; Mill Creek, Mt. LeConte, Oct. 9, 1926, 2 ads., 4 yg.

Georgia: Tallulah Falls, Oct. 18, 1926, 3 ads, 4 yg.; Demorest, April, 1926, 3 ads., M. E. Phillips, coll.

Virginia: Buffalo Creek, 6 miles south of Lexington, July 5, 1927, 13 ads., 4 yg.

Desmognathus fuscus auriculatus (Holbrook)

North Carolina: Maysville, Oct. 23, 1926, 1 ad., 1 yg.; Weldon, Oct. 26, 1926, 1 ad. 88 mm. long, tail 44 mm.

Desmognathus fuscus carolinensis Dunn

Plate 25, figure 13

North Carolina: Big Bald Mt., Oct. 13, 1926, 4 ads.; Mt. Pisgah (Lodge to summit), Oct. 14, 1926, 11 ads.; Frying Pan Mt., Oct. 13, 1926, 4 ads., 3 yg.; Wayah Bald, Oct. 16, 1926, 1 ad. 1 yg.; Wayah Gap, Oct. 16, 1926, 3 ads.

Tennessee: Mill Creek, Mt. LeConte, Oct. 7, 1926, 2 yg.; Mill Creek, Mt. LeConte, Oct. 9, 1926, 2 ads. 1 yg.; Roaring Fork, Mt. LeConte, Oct. 10, 1926, 2 ads.

Georgia: Dick's Creek Gap on line of Rabun and Towns counties, Oct. 18, 1926, 1 ad.

Dunn (Copeia, No. 164, 1927, p. 84) has recently described a new mountain race of *Desmognathus* from Indian Pass, N. C., to which the name *D. fuscus imitator* has been given. The specimens listed above from Mt. LeConte may perhaps, with propriety, be regarded as intergrades between typical *carolinensis* and *imitator* for, as Dunn has pointed out, they are unusually dark below and have the dorsal pattern somewhat obscured.

Two specimens from Roaring Fork, Mt. LeConte, however, seem to me to approach *D. fuscus fuscus* in the form of the body and the slightly keeled tail but in the dorsal pattern and dark venter they are typical *carolinensis*.

Desmognathus phoca (Matthes)

North Carolina: Wilmont, Aug. 15, 1926, 3 ads.; between Swain and Emma, Oct. 15, 1926, 1 ad.; east side of Wayah Gap, Oct. 16, 1926, 3 ads.; Andrews, Oct. 17, 1926, 5 ads.

Tennessee: Laurel Creek near Elkmont, Oct. 8, 1926, 1 ad.; Mt. LeConte, Oct. 7, 1926, 1 young (atypical); Crabtree, July 9, 1927, 16 ads., 19 yg., K. F. Chamberlain, coll.; Crabtree July 11, 1927, 4 ads., 6 yg., K. F. Chamberlain, coll.

Georgia: Demorest, April 1926, 1 ad., M. E. Phillips, coll.

The Andrews, N. C., specimens are very dark above, the pattern being largely obscured. The largest specimens from Crabtree, Ten-

nessee, measure respectively 131 and 129 mm. in length, the smallest transformed specimen 42 mm.

Desmognathus quadra-maculatus (Holbrook)

Plate 26, figure 15

North Carolina: East side Wayah Gap, Oct. 16, 1926, 16 ads., 1 yg.; Wayah Gap, Oct. 16, 1926 (4100 feet elev.), 1 ad.; Wayah Bald, (4100 to about 5000 feet) Oct. 16, 1926, 3 ads., 1 larva; Frying Pan Mt., Oct. 13, 1926, 3 ads.; east fork of Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 2 ads.; between Swain and Emma, Oct. 15, 1926, 3 ads.

Tennessee: Mt. LeConte, Mill Creek below falls, Oct. 9, 1926, 15 ads., 2 yg., 3 larvae; Mill Creek above falls, Oct. 10, 1926, 7 ads., 1 larva; Mt. LeConte, Oct. 7, 1926, (2500–3000 feet elev.), 23 ads.; Mt. LeConte, Oct. 10, 1926 (6400 feet), 5 ads.; Mt. LeConte, Roaring Fork, Oct. 10, 1926, 2 ads.; Laurel Creek near Elkmont, Oct. 8, 1926, 2 ads.; Crabtree, July 11, 1927, 1 ad., 2 yg., K. F. Chamberlain, coll.

Georgia: Tallulah Falls, Oct. 18, 1926, 1 yg. (atypical).

The largest specimen, 170 mm. long, was taken near the summit of Mt. LeConte at an elevation of about 6400 feet. The smallest fully transformed specimen measures only 61 mm. in length.

Leurognathus marmorata Moore

North Carolina: Frying Pan Mt., near Big Pisgah, Oct. 13, 1926, 1 ad.

A single large specimen from a spring run near the summit was taken with several specimens of *Desmognathus quadra-maculatus*. The color pattern is peculiar. There are two widely separated rows of comparatively small, rounded light spots extending from the head along each side of the back and basal half of the tail. The belly is uniformly pigmented, the throat light. The measurements are as follows: Total length 122 mm.; tail 54 mm. Length of head 17 mm.; width 14 mm.

Order SALIENTIA

Family BUFONIDAE

Bufo americanus Holbrook

North Carolina: West side Wayah Gap, Oct. 16, 1926, 1 yg.

Family HYLIDAE

Acris gryllus (LeConte)
North Carolina: Whitakers, Oct. 25, 1926, 1 ad.
South Carolina: Nichols, Oct. 21, 1926, 15 yg. and ads.

Order SQUAMATA

Suborder SAURIA

Family IGUANIDAE

Sceloporus undulatus (Latreille)
Tennessee: Laurel Creek near Elkmont, Oct. 8, 1926, 1 ad.; Crabtree, July 8, 1927, 1 ad., K. F. Chamberlain, coll.
Georgia: Dick's Creek Gap, Oct. 18, 1926, 2 yg.

Family SCINCIDAE

Eumeces fasciatus (Linné)
North Carolina: Maysville, Oct. 23, 1926, 1 yg.

Suborder SERPENTES

Family COLUBRIDAE

Carphophis amoena amoena (Say)
North Carolina: East side Wayah Gap, Oct. 16, 1926, 1 ad., F. N. Blanchard, det.

Diadophis punctatus punctatus (Linné)
South Carolina: Sumter, Oct. 20, 1926, 1 ad., F. B. Blanchard, det.

Diadophis punctatus edwardsii (Merrem)
North Carolina: East side Wayah Gap, Oct. 16, 1926, 10 eggs, 1 yg.; between Swain and Emma, Oct. 15, 1926, 1 ad.
Georgia: Dick's Creek Gap on line between Rabun and Towns Counties, Oct. 18, 1926, 1 ad., F. N. Blanchard, det.
The eggs found on the east side of Wayah Gap were clustered together beneath a large flat stone by the side of the road, and were hatching when discovered, two or three snakes being partly out of the shells. When exposed to the light they promptly withdrew. The eggs with the soil

on which they were resting were transferred to a tight box and kept until the entire complement hatched.

Heterodon contortrix (Linné)
South Carolina: Sumter, Oct. 20, 1926, 1 yg.

Lampropeltis triangulum triangulum (Lacépéde)
Tennessee: Laurel Creek near Elkmont, Oct. 8, 1926, 1 ad.

Natrix sipedon sipedon (Linné)
Tennessee: Rough Creek near Elkmont, Oct. 8, 1926, 2 yg.

Storeria occipito-maculata (Storer)
North Carolina: Andrews, Oct. 17, 1926, 1 ad.

Thamnophis sirtalis sirtalis (Linné)
North Carolina: East side Wayah Gap, Oct. 16, 1926, 1 ad.; Big Bald Mt., Oct. 13, 1926, 1 ad., 1 yg.
Tennessee: Rough Creek near Elkmont, Oct. 8, 1926, 1 yg.

Order TESTUDINATA

Family TESTUDINIDAE

Terrapene carolina carolina (Linné)
North Carolina: Weldon, Oct. 26, 1926, 1 yg.

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ALBANY, N. Y.

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EXPLANATION OF PLATES 23–26

PLATE 23

Fig. 1. *Ambystoma mabeei* n. sp. Outline drawing to show the shape, proportions and costal grooves. Actual length 100 mm.

Fig. 2. Same. Mouth parts to show the character of the tongue and teeth.

Fig. 3. *Ambystoma texanum* (Matthes). Inside of mouth.

Fig. 4. *Ambystoma opacum* (Gravenhorst). Inside of mouth.

Fig. 5. *Ambystoma talpoideum* (Holbrook). Inside of mouth.

Figures 2 to 5 are drawn to the same scale.

PLATE 24

Fig. 6. *Eurycea bislineata wilderae* Dunn. Female from Mt. LeConte, Tenn., taken Oct. 10, 1926. Actual length about 100 mm.

Fig. 7. *Plethodon metcalfi* Brimley. Frying Pan Gap, N. C., Oct. 12, 1926. Actual length 106 mm.

Fig. 8. *Plethodon shermani* Stejneger. East side Wayah Gap, N. C., Oct. 16, 1926. Actual length 130 mm.

Fig. 9. *Plethodon jordani* Blatchley. Mt. LeConte, Tenn., Oct. 9, 1926. Actual length 92 mm.

PLATE 25

Fig. 10. *Aneides aeneus* (Cope and Packard). Tallulah Falls, Ga., Oct. 18, 1926. Actual length about 35 mm. Young specimen photographed Nov. 16, 1926, to show beginning of regeneration of tail.

Fig. 11. Same specimen as in figure 10 photographed Dec. 16, 1926. Note expanded toe tips and rudimentary 1st finger and toe.

Fig. 12. Same specimen photographed Feb. 3, 1927. At the time this photograph was made, yellow pigment had appeared in small flecks on the stub.

Fig. 13. *Desmognathus fuscus carolinensis* Dunn. Natural size. A specimen which may be regarded as intermediate in character between *D. fuscus carolinensis* and *D. fuscus imitator* Dunn. Mill Creek, Mt. LeConte, Tenn., Oct. 9, 1926.

PLATE 26

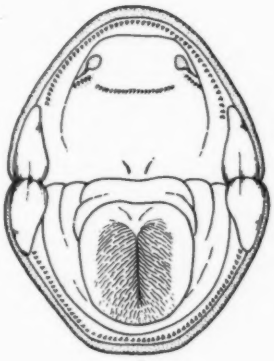
Fig. 14. *Gyrinophilus danielsi* Blatchley. Near summit of Mt. LeConte, Tenn., Oct. 10, 1926. Natural size.

Fig. 15. *Desmognathus quadra-maculatus* (Holbrook). Adult, natural size from Mill Creek, Mt. LeConte, Tenn., Oct. 10, 1926.

Fig. 16. *Pseudotriton ruber schencki* Brimley. Elkmont, Tenn., Oct. 11, 1926. Natural size.

PLATE 23

1



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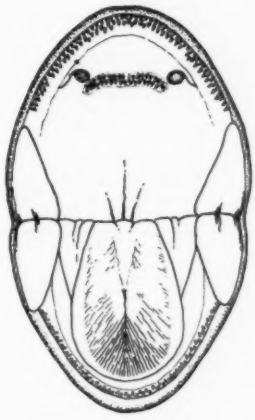

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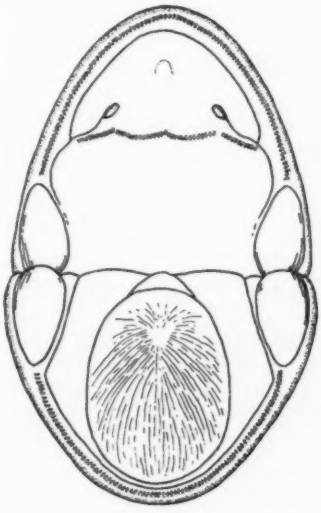

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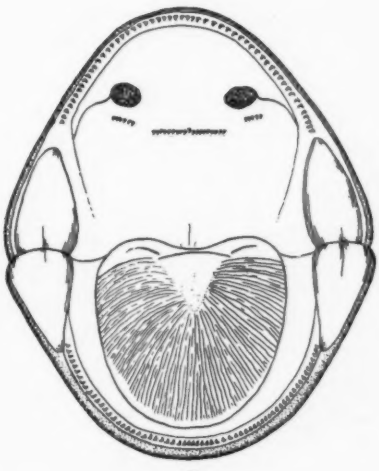

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PLATE 24

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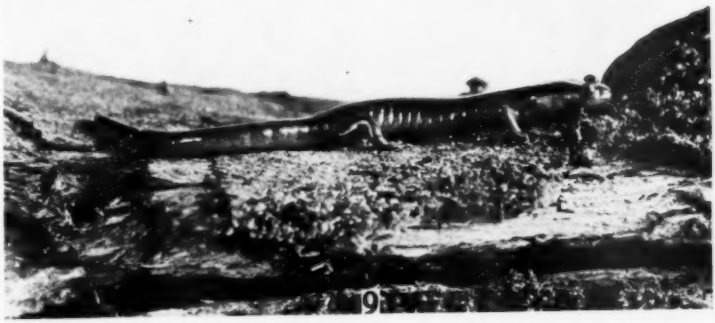

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PLATE 25

10

11

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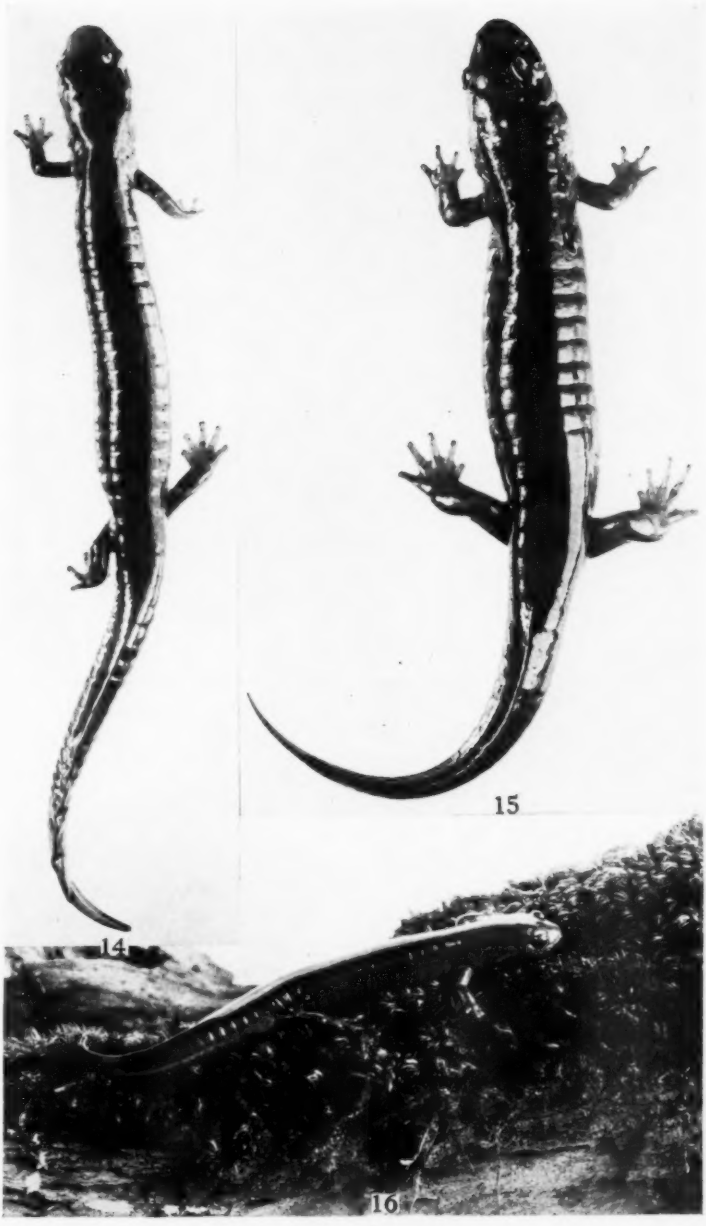
PLATE 26



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ARACHNIDS FOUND ON NIGERIAN RODENTS AND INSECTIVORES

By A. S. Pearse

During the latter half of the year 1926 the writer collected rodents and insectivores in Nigeria for the purpose of studying their parasites. From August 1 to October 16 animals were trapped and shot in the villages and in the wet forest near Lagos; from October 25 to November 2 and from November 10 to November 20, in the guinea grass near Ibadan and Oyo; November 3 to November 7, in the rain forest about Ife; and November 28 to December 11 on the border of the desert about Kano. A general account of the country has been given elsewhere (Pearse, 1927, 1928). In working up the collections assistance has been received from Maj. C. M. Ingoldby, of the British Museum of Natural History, who identified all the mammals; Dr. H. E. Ewing, of the United States Bureau of Entomology, who classified the mites; and Dr. Cecil Warburton, of the Molteno Institute, who helped identify certain of the ticks.

Most of the rodents were caught in steel traps. They were placed in tight cloth bags as soon as they were removed from the traps and care was taken to prevent the loss of as few ectoparasites as possible. The results of the observations are summarized in Tables I and II.

Ticks

Table I shows that ticks are most abundant on the small mammals which live near Kano, on the border of the desert, fewer on those in the guinea grass, and fewest in the forest. Larger animals more often carry ticks than small. Every individual of the following species carried ticks: *Arvicanthis rufinus*, a small rodent somewhat like a guinea pig, which lives in the guinea grass and in the rain forest about Ife; the hedgehogs, *Atelerix spiculus* and *A. spinifex;* the squirrel which is found in the wet forest and commonly feeds in the fields of the natives, *Euxerus erythropus moestus;* the rabbit which lives in the guinea grass, *Lepus zechi;* and the gigantic "cut-grass" found in the forest and guinea grass, *Thrynomys swinderianus*. Other species which show high percentages

TABLE I

TICKS COLLECTED FROM NIGERIAN RODENTS AND INSECTIVORES

In tabulations of the infestations under each species, the first figure indicates the number of mammals infested and the second, the total number of parasites found. The localities are: *If*, Ife; *Ib*, Ibadan; *K*, Kano; *L*, Lagos.

MAMMALS	Locality	Number examined	TICKS: *Izodes rasus* Neumann	*Izodes* (larva)	*Rhipicephalus sanguineus* Latreille	*Rhipicephalus everisi albigeniculatus* Warburton	*Haemaphysalis leachi* Audouin	*Hyalomma aegyptium* Linnaeus	*Amblyomma variegatum* Fabricius	Unknown	Total	Per cent infested	Parasites per individual
Aenomys hypoxanthus Puch	If	1									0	0	0
Arvicanthis mordax Temm	K	9					6				6	67	2.3
							21				21		
Arvicanthis rufinus Thomas	Ib		4				4				6	100	21.3
	If	6	17				111				128		
Atelerix spiculus Thomas and Wroughton	K	5			1		5		1		5	100	15.4
					1		73		3		77		
Atelerix spinifex Thomas	K	2			2		1				2	100	3.5
					4		3				7		
Cricetomys buchanani Thomas	K	10				1	1			2	3	30	0.6
						1	3			2	6		
Cricetomys emini Wroughton	If		10								10	56	7.8
	L	18	140								140		
Crocidura sp?	Ib	15	1	1			1				3	20	0.2
	L		2	1			2				5		
Crocidura manni Pet.	Ib	19	1				5				6	31	12.8
	KL		9				245				254		
Euxerus erythropus moestus Thomas	L	2					1			1	2	100	12.0
							21			1	22		

TABLE I—*Continued*

MAMMALS	TICKS												
	Locality	Number examined	*Ixodes rasus* Neumann	*Ixodes* (larva)	*Rhipicephalus sanguineus* Latreille	*Rhipicephalus evertsi albigeniculatus* Warburton	*Haemaphysalis leachi* Audouin	*Hyalomma aegyptium* Linnaeus	*Amblyomma variegatum* Fabricius	Unknown	Total	Per cent infested	Parasites per individual
Funisciurus anerythrus Thomas	If						1				1	8	0.3
	L	12					3				3		
Funisciurus auriculatus olivae Dollman	L	5										0	0
Heliosciurus isabellinus Gr.	L	3										0	0
Hybomys univittatus Pet.	L	44	1	1			1				2	5	0.1
			1	1			2				4		
Leggada musculoides Temm	Ib	48	1	1			2				4	9	0.2
	KL		2	2			3				7		
Lemniscomys striatus L.	Ib	24	1	3	2		8				14	59	3.3
	IfL		2	13	7		64				86		
Lepus zechi Matsch.	Ib	2			1		2	1			2	100	5.5
					1		9	1			11		
Lophuromys sikapusi Temm	Ib	11					1				1	9	0.1
	IfL						1				1		
Malacomys edwardesi Rochebr.	L	20										0	0
Mastomys sp?	If	4										0	0
Mastomys erythroleucas Temm	Ib	31	2				1				3	10	0.2
	IfL		3				2				5		
Mus musculus L.	L	3										0	0
Praomys tullbergi Thomas	L	96			1		24			1	26	27	2.0
					1		195			1	197		

TABLE 1—*Concluded*

MAMMALS	Locality	Number examined	TICKS: *Ixodes rasus* Neumann	*Ixodes* (larva)	*Rhipicephalus sanguineus* Latreille	*Rhipicephalus evertsi albigeniculatus* Warburton	*Haemaphysalis leachi* Audouin	*Hyalomma aegyptium* Linnaeus	*Amblyomma variegatum* Fabricius	Unknown	Total	Per cent infested	Parasites per individual
Protoxerus stangeri nigeriae Thomas	If	1									0	0	0
Rattus rattus L.	If	78	1				1				2	3	+
	L		2				1				3		
Taterillus gracilis angelus Thomas	K	9	2		1		3		1		6	67	1.6
			4		4		5		1		14		
Taterona kempi Wroughton	Ib	26			4		11				15	58	6.9
	K				85		64				149		
Thrynomys swinderianus Temm	L	1	1		1		1				1	100	28.0
			14		13		1				28		
Uranomys foxi Thomas	Ib	1									0	0	0
Lagos	L	356	15	5	3		38			2	59	16.6	1.34
			161	6	18		286			2	478		
Ibadan, Oyo	Ib	69	2	2	6		18	1			29	42	4.3
			11	12	88		184	1			296		
Ife	If	27	3		1		1				5	18.5	0.22
			4		1		1				6		
Kano	K	54	2		4	1	22		2	2	33	67	6.9
			4		9	1	353		4	2	373		

of infestation are the desert guinea pig, *Arvicanthis mordax* (67), the desert jumping mouse, *Taterillus gracilis angelus* (67); the diurnal, striped squirrel of grass fields, *Lemniscomys striatus* (59); the field rat which is characteristic of the guinea grass and desert, *Taterona*

kempi (58); the great gambian rats, *Cricetomys emini* (56) and C. *buchanani* (30); and the widely distributed shrew, *Crocidura manni* (31).

Animals on which ticks were never found were the tree squirrels, *Protoxerus stangeri nigeriae*, *Heliosciurus isabellinus*, and *Funiscuirus auriculatus olivae;* the house mouse, *Mus musculus;* the rain forest ground mouse, *Mastomys* sp; the wet forest, long-tailed, and strictly nocturnal mouse, *Malacomys edwardesi*. The black rat, *Rattus rattus* (3); the short-tailed, wet forest mouse, *Hybomys univittatus* (5); and the tree squirrel, *Funisciurus anerythrus* (8), also showed infrequent infestations. These observations indicate that small mammals which live in the trees, on the ground in the depths of the forest, or in human habitations are not often attacked by ticks.

Considering the average number of ticks per individual, the one with the greatest number is the large cut-grass, *Thrynomys swinderianus* (28); the desert and guinea grass mammals of good size, *Arvicanthis rufinus* (21.3), and *Atelerix spiculus* (15.4); the shrew, *Crocidura manni* (12.8); and the field-frequenting tree squirrel, *Euxerus erythropus moestus* (12). The large gambian rats, *Cricetomys emini* (7.8) and *C. buchanani* (0.6), which live in burrows and come out to feed at night, do not show a very high number. The pigmy mouse which lives among grass, *Leggada musculoides* (0.2), also carries few ticks.

The ideal host for a tick is apparently a large animal, with rather long, coarse hair, which lives among low vegetation in a dry climate. Animals which are small in size, nocturnal, strictly arboreal, or which live on the ground in the depths of forests, are not often attacked.

Among the species of ticks observed, *Haemaphysalis leachi* was by far the most abundant. Rather common species were *Ixodes rasus* and *Rhipicephalus sanguineus*. Other species were rare. No argasids were observed to occur on any rodent or insectivore. They doubtless attack such small mammals, but make such a short stay that they are difficult to capture.

MITES

The distribution of mites on hosts (table II) is quite different from that of ticks. In general all percentages of infestation are higher. Considering the percentage of host animals infested only three rather rare animals show 100 per cent, *Aenomys hypoxanthus*, *Lepus zechi*, and *Thrynomys swinderianus*. The first of these is small and the other two are the largest of the animals studied. The long-tailed mouse of the deep forest, *Praomys tullbergi*, which carries no ticks, has a rather

TABLE II

MITES COLLECTED FROM NIGERIAN RODENTS AND INSECTIVORES

In tabulations of the infestations under each species, the first figure indicates the number of mammals infested and the second the total number of parasites found. The localities are: *If*, Ife; *Ib*, Ibadan, Oyo; *K*, Kano; *L*, Lagos.

MAMMALS	MITES															
	Locality	Number examined	*Heterolaelaps* sp.?	*Laelaps* sp?	*Laelaps algericus*? Hirst	*Laelaps liberiensis* Hirst	*Laelaps muricola* Trigildh	*Laelapinae genus*?	*Tricholaelaps*?	*Tricholaelaps* sp.?	*Trombicula*, larvae	*Uropoditae*, nymphs	Unknown	Total	Per cent infested	Parasites per individual
Aenomys hypoxanthus	If	1		1										1	100	1
				1										1		
Arvicanthis mordax	K	9													0	0
Arvicanthis rufinus	Ib	6		4										4	67	9
	If			54										54		
Atelerix spiculus	K	5													0	0
Atelerix spinifex	K	2													0	0
Cricetomys buchanani	K	10						3						3	33	1.5
								15						15		
Cricetomys emini	If	18						3			1		1	4	36	8.2
	L							58			40		50	148		
Crocidura sp?	Ib	15		1			1	1			8			10	67	27.6
	L			3			1	20			390			414		
Crocidura manni	Ib	19		1				1					2	4	21	3.3
	KL			11				1					50	62		
Euxerus erythropus moestus	L	2		1										1	50	1
				2										2		
Funisciurus anerythrus	If	12						3			5			7	58	12.9
	L							9			146			155		
Funisciurus auriculatus olivae	L	5					1				4			4	80	134.2
							1				670			671		

TABLE II—*Continued*

MAMMALS	MITES																
	Locality	Number examined	*Heteroleelaps* sp.?	*Laelaps* sp?	*Laelaps algericus*? Hirst	*Laelaps liberiensis* Hirst	*Laelaps muricola* Trägårdh	*Laelapinae* genus?	*Tricholaelaps*?	*Tricholaelaps* sp?	*Trombicula* larvae	*Uropodidae*, nymphs	Unknown	Total	Per cent infested	Parasites per individual
Heliosciurus isabellinus.....	L	3													0	0
Hybomys univittatus.....	L	44		1				4			5			9	20	3.4
				2				30			118			150		
Leggada musculoides.....	Ib	48		9	16	1			1					25	52	2.0
	KL			39	48	7			4					98		
Lemniscomys striatus.....	Ib	24		13			3	5						21	88	10.5
	IfL			154			37	62						253		
Lepus zechi.....	Ib	2		2										2	100	5.5
				11										11		
Lophuromys sikapusi.....	Ib	11	4					1	2		2		1	8	73	20.4
	IfL		160					2	21		40		1	224		
Malacomys edwardesi.....	L	20	2				4				2			8	40	3.2
			13				21				40			64		
Mastomys sp?....	If	4					2							2	50	0.5
							2							2		
Mastomys erythroleucas.....	Ib	31	3	3		1	19						1	27	87	12.8
	IfL		15	13		15	353						1	396		
Mus musculus.....	L	3													0	0
Praomys tullbergi.....	L	96		1			63	10			1	1		73	76	4.5
				11			368	54			2	4		439		
Protoxerus stangeri nigeriae....	If	1													0	0
Rattus rattus.....	If	78		14					1				1	16	21	0.4
	L			20					5				3	28		

TABLE II—*Concluded*

MAMMALS	MITES															
	Locality	Number examined	*Heteroleelaps* sp.?	*Laelaps* sp?	*Laelaps dipericus*? Hirst	*Laelaps liberiensis* Hirst	*Laelaps muricola* Trägårdh	*Laelapinae* genus?	*Tracholaelaps*?	*Tracholelaps* sp?	*Trombicula*, larvae	*Uropodidae*, nymphs	Unknown	Total	Per cent infested	Parasites per individual
Taterillus gracilis angelus...	K	9						2						2	22	1.3
								12						12		
Taterona kempi..	Ib	26				1		21	2					24	93	35.0
	K					25		872	14					911		
Thrynomys swinderianus.....	L	1									1			1	100	20.0
											20			20		
Uranomys fozi....	Ib	1													0	0
Lagos.....	L	356	2	38	16	2	74	20	2	1	27	1	4	186	52	7.7
			58	211	48	22	734	170	25	4	1,413	4	64	2,753		
Ibadan, Oyo..	Ib	69	5	13		1	4	25	2		2			49	71	19.5
			117	118		25	83	937	14		55			1,349		
Ife.....	If	27		2			13	2	1					17	63	10.4
				10			267	3	1					281		
Kano.....	K	54					2	8					3	13	24	1.7
							5	33					51	89		

high percentage of infestation (76), and the two desert hedgehogs, *Atelerix spiculus* and *A. spinifex*, which always bear ticks, have no mites. If the number of mites per individual is considered, the animals showing the highest degrees of infestation are a tree squirrel, *Funisciurus auriculatus olivae* (134.2); a grass rat, *Taterona kempi* (35), a forest shrew, *Crocidura* sp. (27.6); a grass mouse, *Lophuromys sikapusi* (20.4); the cut-grass, *Thrynomys swinderianus* (20); a tree squirrel, *Funisciurus anerythrus* (12.9), a grass-inhabiting rat, *Mastomys erythroleucas* (12.8); and a striped ground-squirrel, *Lemniscomys striatus* (10.5). The animals which have little or no infestation are the desert hedgehogs and guinea pig, *Arvicanthis mordax*, the tree-top squirrels, *Protoxerus stangeri nigeriae* and *Heliosciurus isabellinus*, the house mouse and black rat

(0.4); the forest rat, *Mastomys* sp. (0.5); the field-visiting tree squirrel, *Euxerus erthropus moestus* (1); and the desert jumping mouse, *Taterillus gracilis angelus* (1.3).

Apparently the chief factor which favors mites is the presence of low vegetation. It is known that some mites cannot stand direct sunlight and are easily eliminated from pastures where the grass is kept short (Ewing, 1921). The scanty vegetation of the desert does not offer enough cover. Small mammals which run among low thick vegetation, whether it be the comparatively dry guinea grass or the dew-laden undergrowth of the wet forest, are infested with mites. The gigantic rain forest near Ife makes such a dense canopy that little plant ground-cover grows beneath it, and there are few mites. All the rodents and insectivores which frequent grass have plenty of mites, regardless of their size. The relation of mites to thick, low vegetation is particularly well shown by the tree squirrels. Those which live in the wet forest near the coast, where the trees are not very tall and where there is plenty of undergrowth are heavily infested with mites—*Funisciurus auriculatus olivae* (134.2) and *Funisciurus anerythrus* (12.9). The tree squirrel which lives in somewhat denser wet forest and visits the cultivated, rather open fields of the natives has a rather low infestation (*Euxerus erthropus moestus*, 1). Those which remain in the tree tops in the dense wet forest (*Heliosciurus isabellinus*) or in the rain forest (*Protoxerus stangeri nigeriae*) carry no mites.

The identification of mites is difficult and tedious. There are many undescribed species and genera in all parts of the earth. Many of the specimens taken on mammals are immature and difficult to determine accurately. Those reported in this paper are common in Africa. The *Laelapinae* are generally parasites on small mammals. *Trombicula* is a genus of harvest mites, *Trombidiidae*, which usually prey on insects but may, particularly as larvae, attack other small animals. *Uropodidae* commonly attach themselves to insects and other small animals for purposes of transportation and many are not parasitic (Banks, 1915).

DISCUSSION AND CONCLUSIONS

Of the four types of arthropods collected on Nigerian rodents only the mites and ticks are considered in this paper. The fleas and lice will be discussed elsewhere. It seems proper to mention, however, that the chief factors which influence the abundance or scarcity of such parasites on their hosts are quite different in each of these groups.

In Nigeria only five species of lice were found on five different hosts, and all these were rare or uncommon. Most species of lice are so specialized for particular hosts that the chief factor for their occurrence is the presence of the necessary host, to which they remain rather closely attached. Fleas flourish best on hosts which live in a dry climate and have a more or less permanent home, such as a burrow or a human habitation. The wandering small mammals in a damp forest have few or no fleas. House rats and the burrowing gambian rats frequently carry them. Fleas have particular importance in relation to the spread of plague and it is of interest that only rodents which frequent dwellings, warehouses, ships, or burrows are commonly infested with them (Pearse, 1928a).

Ticks may be abundant in a wet or a dry climate, but perhaps do best in the latter. For a tick the ideal host is a large animal which walks about on the ground among scattered low vegetation and has rather long coarse hair. Very small animals, those which are strictly arboreal or nocturnal, and which live on the ground in the dense shade of a rain forest are not often subject to infestation. Mites are dependent on low, close-growing vegetation which covers the ground. If host animals frequent such situations, they are often attacked.

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A NEW TREMATODE FROM THE NEWT TRITURUS VIRIDESCENS

By Fred J. Holl

Plate 27

While examining *Triturus viridescens* Rafinesque for parasites 104 flukes belonging to apparently a new genus of the family Plagiorchiidae Luhe were found. These parasites occur in both the red eft (terrestrial stage) and in the newt (aquatic stage) of the salamander. The hosts were collected in an old settling pond near Durham, N. C., and in the woods along its shores.

Triturus viridescens commonly spends part of its life cycle as a terrestrial salamander and part as a fresh water newt common throughout the Eastern United States. After a short larval life, *Triturus* metamorphoses into a brilliant orange salamander with vermilion spots and is commonly found on land under logs. Following a terrestrial life of from one to four years it assumes a brownish or greenish color and enters the water. The parasite occurs in both the terrestrial and aquatic stages. The uterus and sex glands show a marked difference in appearance in the two habitats.

Plagitura, New Genus

Family Plagiorchiidae. With the genital pore between the esophagus and acetabulum. Testes in posterior third of body. A short prepharynx, pharynx, oesophagus, and intestinal crura which terminate immediately anterior to the testes. The vitellaria are follicular in structure, lateral to and about equal in extent to the crura. The uterus has many coils and extends from the acetabulum to near the posterior end. Excretory system is lobate and Y-shaped.

Type species: *Plagitura salamandra.*

Plagitura salamandra new species

Length, 2.52 mm.; width opposite acetabulum, 0.9 mm. The body wall is smooth and does not have cuticular spines as do most members of the family Plagiorchiidae. The anterior end of the body is protruded

into a slender projection when active. Oral sucker is at the anterior end and has a diameter of 0.19 mm. Diameter of acetabulum, 0.31 mm.

The mouth is located within the oral sucker and opens into a prepharynx which is followed by a muscular pharynx, oesophagus, and two intestinal crura. The crura extend to about the posterior third of the body, terminating just anterior to the testes, and have an average diameter of 0.55 mm.

The ovary, 0.13 x 0.15 mm., is lobate and located on the right side of the body close to the margin of the acetabulum. Posterior to the ovary is the shell gland. The uterus, filled with eggs, coils caudad from the shell gland passing into the posterior region. It then coils cephalad to the genital pore, which is near the anterior margin of the acetabulum and slightly to the left of the median line. The eggs measure 0.035 x 0.012 mm. and are covered by a thin shell. The testes are lobate and located posterior to the intestinal crura and from them the vasa deferentia extend forward to the region of the acetabulum to form a large cirrus sac which opens to the outside through the genital pore. The vitellaria are follicular in structure, lateral to, and about equal in extent to the crura.

Excretory system, Y-shaped. The excretory tube forms a lobed bladder from the excretory pore to about the region opposite the termination of the crura. Anterior to this region the system becomes tubular and then branches into two tubes which extend to the region of the shell gland (fig. 3). The excretory system has been studied from both sections and toto mounts.

In the specimens of *Plagitura salamandra* from the aquatic newt the uterus is filled with eggs and occupies a large part of the body (fig. 1). In specimens from the terrestrial eft the uterus contains very few eggs and is but slightly coiled. The ovary, testes and vitellaria are smaller than in specimens from the newt (fig. 2). One salamander collected from under a log and having a color similar to the aquatic stage contained a fluke with large number of eggs and appeared similar to those taken from the newts.

The aquatic newts often contain small specimens approximately 1.45 mm. in length. These small parasites have the uterus coiled and filled with eggs (fig. 4).

Apparently the parasite enters the salamander during the aquatic stage and continues to live in the host while it is on land but during the terrestrial life the sexual organs cease to function.

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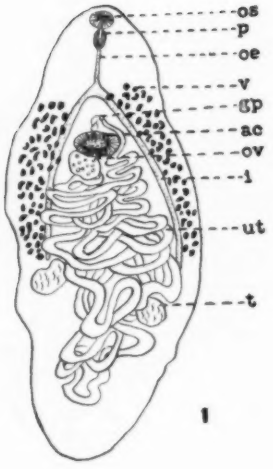
PLATE 27



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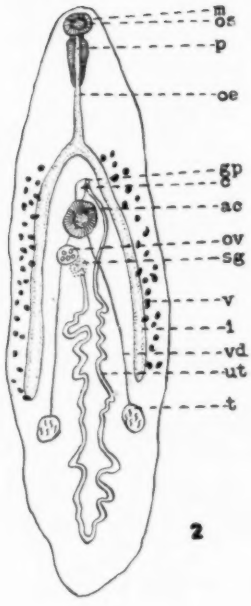

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EXPLANATION OF PLATE 27

All drawings made with aid of camera lucida

Fig. 1. Plagitura salamandra, from the newt stage. × 27.
Fig. 2. Plagitura salamandra, from the eft stage. × 27.
Fig. 3. Plagitura salamandra, from the newt stage, showing excretory system. × 27.
Fig. 4. Plagitura salamandra, small specimen from the newt. × 27.

Abbreviations

ac, acetabulum
c, cirrus
ep, excretory pore
gp, genital pore
i, intestinal crus
m, mouth
oe, oesophagus
os, oral sucker
ov, ovary
p, pharynx
sg, shell gland
t, testes
ut, uterus
v, vitellaria
vd, vas deferens

TWO NEW NEMATODE PARASITES

By Fred J. Holl

Plate 28

During the writer's examination of fish and amphibians two apparently new species of nematode parasites have been found. The seasonal variation of these species are being studied and will be described in a future paper.

Spinitectus carolini n. sp.

Found in the intestine of the pumpkinseed, *Eupomotis gibbosus* (Linnaeus), and the Warmouth bass, *Chaenobryttus gulosus* (Cuvier and Valencienns). One specimen has also been found in the intestine of the salamander, *Triturus viridescens* Rafinesque. The hosts were collected near Durham, North Carolina.

Mature females 5.75 to 10 mm. long. Specimen described 10 mm. long; anterior end with sixteen distinct rings of hooks projecting caudad from posterior margin of each annulus. Width opposite third row of hooks 0.004 mm., middle region of body 0.0055 mm.

There are about 110 circlets of spines; first sixteen or seventeen rows being distinct; the following rows appear only as striations; first row begins 0.1 mm. from anterior end; following fifteen rings of hooks about 0.015 mm. apart; posterior rings somewhat closer together than the anterior; about thirty spines in anterior rows.

Vulva about one third the length of body from the posterior end. Uterus with many eggs. Eggs oval, 0.03 by 0.015 mm.

Mouth terminal, with three lips; opens into a conoid shaped pharynx. Oesophagus arises at about the middle of the terminal segment; muscular in structure to about the fourteenth circle of spines after which it becomes granular. Intestine arises in region of vulva. Anus 0.12 mm. from posterior end.

Males 5.25 to 10.75 mm. long. Male described: 10.75 mm. long; posterior end coiled; anus 0.12 mm. from posterior end. Two spicules present; the longer, narrow, 0.17 mm. long, curved, pointed at both ends; the shorter, 0.098 mm. long, flat, proximal end with incurved hook-like processes, distal end with a point and also a hook projecting cephalad.

Fourment (1883 and 1884) established the genus *Spinitectus* and described *S. oviflagellis* as a parasite of *Merlangus vulgaris*. Linton (1901) described under the name *Filaria serrata*, a parasite from the hake, *Phycis tenuis*, which Railliet and Henry (1915) placed in this genus as *S. cristatus*. Ward and Magath (1916) described *S. gracilis* from fresh-water fishes collected at Fairport, Iowa. As far as the writer knows *S. gracilis* is the only species of *Spinitectus* so far reported from the fresh-water fishes of North America. The genus includes Spiruoidea having a series of transverse rings to which a circle of posteriorly projecting spines are attached. These spines gradually become smaller in size towards the posterior end. Males have tails coiled. Females, tail straight, vulva in posterior part of body. Eggs small, ellipsoidal with a thick shell.

Spinitectus carolini differs from *S. gracilis*, the other species described for American fresh-water fishes, by having papilla present. The smaller spicule is quite different from that figured for *S. cristatus* having at the distal end a hook directed caudad. At the proximal end there are two sharp curved processes. There are no preanal plates in *S. carolini* though present in *S. cristatus*.

Cosmocerca dukae n. sp.

This nematode has a cuticle about 0.0057 mm. thick which is arranged in rings. Male: length, 2.55 mm.; width opposite bulb of oesophagus, 0.1102; middle of body, 0.153 mm.; opposite anus, 0.136 mm. Mouth surrounded by three small lips. Oesophagus typically oxyuroid; narrow region, 0.396 mm. long; 0.0266 mm. wide; bulb 0.085 mm. long, 0.088 mm. wide. Anus 0.24 mm. from posterior end. On ventral side are twelve pairs of circular plectanes, one pair postanal, eleven pairs preanal. Gubernaculum, 0.102 mm. long, proximal end narrower than distal, both ends blunt. Two equal spicules, 0.29 mm. long.

Female: length, 3.066 mm.; width, opposite bulb of oesophagus, 0.127 mm., middle of body, 0.1645 mm., opposite anus, 0.056. Anus, 0.124 mm. from posterior end. Oesophagus similar to male, anterior region, 0.408 mm. long; bulb 0.077 mm. long, and 0.0910 mm. wide. Vulva 1.826 mm. from anterior end.

The genus *Cosmocerca* was established by Diesing (1861) to include *C. ornata* Diesing and *C. commutata* Diesing. Synonyms for the genus are *Nematoxys* Schneider, 1866, and *Ananconus* Railliet and Henry, 1916.

Yorke and Maplestone (1926) write "The literature dealing with this genus is very complicated, but as far as it is possible to ascertain,

there appear to be three species, viz., *C. trispinosa*, having four rows of plectanes and a trifid tail, *C. ornata*, having four rows of plectanes and a simple tail, and *C. commutata*, having two rows of plectanes and a simple tail.

This genus is placed in the Oxyuroidea family Cosmocercinae Railliet, 1916. The worms included have a mouth with three lips; oesophagus cylindrical with posterior region forming a lobe. Males with gubernaculum; spicules equal; posterior end curved and ending in one or three points; two or four rows of plectanes. Female with vulva in front of middle of body. Parasites in intestine of amphibia.

As far as the writer has been able to learn there have been no species of this genus recorded for North American amphibians. Steiner (1924) reports *Cosmocercella haberi* Steiner, a closely related genus from the tree frog *Hyla carolinensis*. The species found by the writer occur in the colon and intestine of the salamander, *Triturus viridescens* Rafinesque, collected at Durham, N. C.

In this species the vulva is posterior to the middle of the body, thus differing from the generic characteristics, but the writer does not wish to create a new genus on account of this slight divergence.

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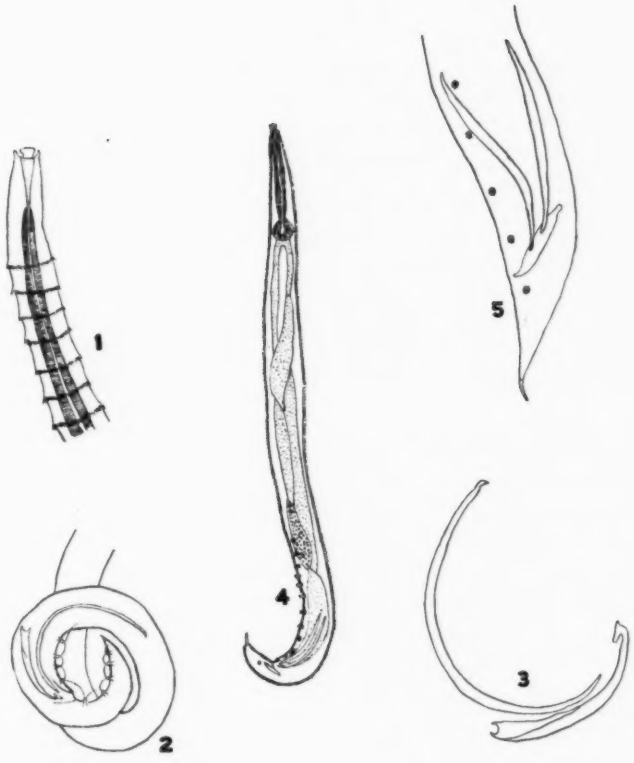
EXPLANATION OF PLATE 28

All figures drawn with the aid of a camera lucida

Fig. 1. *Spinitectus carolinius*, anterior end. × 195.
Fig. 2. *Spinitectus carolinius* male, posterior end showing spicules. × 183
Fig. 3. *Spinitectus carolinius*, spicules of male. × 325.
Fig. 4. *Cosmocerca dukae* male. × 38.
Fig. 5. *Cosmocerca dukae* male, posterior end showing spicules and gubernaculum. × 183.

PLATE 28



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THE INFLUENCE OF ULTRA-VIOLET RADIATIONS ON THE BLOOD SUGAR OF THE RABBIT

By F. G. Hall, Duke University, and R. W. Root, Milton College

The influence of ultra-violet radiations has been widely studied during the past decade. However, the interpretation of many of the results is still uncertain. Perhaps this is because there is a great deal of general knowledge pertaining to the effects of radiant energy but little concerning specific details. Through the accumulation of carefully controlled specific investigations, it will be possible to obtain a more satisfactory knowledge of the physiologic effect of light. In this paper the results of experiments on the influence of ultra-violet radiation on the blood sugar of rabbit are reported. An attempt was made to separate the factors which tend to eclipse the influence of ultra-violet and by so doing make the results subject to more careful analysis. The data presented are not conclusive, but rather indicate a course of procedure for further investigation.

Investigators have used different sources of light in the study of the influence of ultra-violet on sugar metabolism. Pincussen (1922) used a carbon arc and his results indicate that such radiations increase the reducing power of glucose. He irradiated serum *in vitro* and found that the sugar diminished more rapidly than it did in darkness. A similar reaction took place with whole blood. *In vivo* he found that irradiated rabbits had a higher blood sugar after adrenalin injections than those not irradiated and construed this to mean that the radiation influenced the sympathetic system. He irradiated diabetes after injection of eosin with mercury quartz lamps and obtained a decrease in the blood sugar. Rothmann (1924) found what he thought to be a rise in the sugar tolerance after light treatment. Block and Faber (1925) report a decrease in diabetic children. They concluded that the decrease was due to increased oxidation caused by an increased secretion of insulin.

Methods

Rabbits fed on a normal diet were used in this work. Blood samples were taken from the ears for sugar determinations just before and just

after exposure to the ultra-violet. Two determinations were usually made upon each sample for the sake of checking results. One cubic centimeter of blood, prevented from clotting by means of lithium oxalate, was used in each determination. The sugar in the blood before exposure and that in the blood after exposure was read by the same standard on the colorimeter so as to prevent any error that might occur because of the differences between two sets of standards. The Folin-Wu blood sugar method was employed.

The rabbits used in the experiments were radiated for different lengths of time, the shortest being ten minutes, and the longest sixty minutes. They were exposed in series, the first set of rabbits being radiated ten minutes, the second set twenty minutes, the third thirty minutes, and so on until six different sets of rabbits had been exposed under this system of ten minute increments. No two sets contained duplicate animals.

In order to see if the results obtained were due to the ultra-violet rays, the experiment was repeated, radiating the same rabbits in the same order except that the rabbits were placed in a glass cage before they were radiated. By this method most of the ultra-violet would be prevented from striking the animal.

A Burdick quartz mercury arc lamp was used in the experiments and was maintained at 60 volts at a distance of 46 cm. from the back of the rabbit. An electric fan was kept running a few feet away from the animal during exposure. This was to circulate the air and to remove any gases that might be generated by the burner.

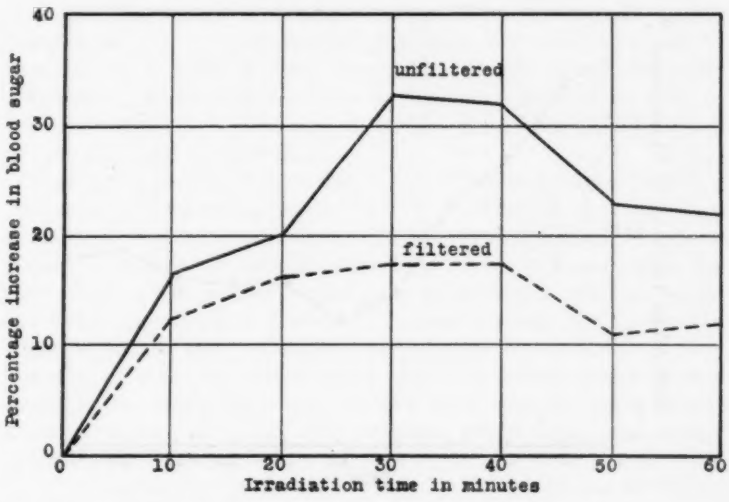
INCREASED RESISTANCE STUDIES

Some of the results in experiments on the effect of ultra-violet light on blood sugar *in vivo* seemed to suggest that the rabbits built up a resistance to the effects of the light. After a single rabbit had been exposed several times the results on the sugar were not so marked in some cases.

In order to see if the blood sugar was really indicating an increased resistance, three healthy rabbits were under the same conditions simultaneously exposed to the light for the same length of time (30 minutes) every other day for twelve times. The changes in the blood sugar were observed after each radiation. The results were plotted so that the change in blood sugar after each consecutive radiation could be compared with the preceding result and with the value obtained after the initial exposure. The results are shown in graph II and indicate

that there is an increased resistance offered to the radiations from a mercury vapor lamp. This continues to about the eleventh day under the conditions of this experiment and then slowly decreases from that time on to the end of the experiment on the twenty-first day.

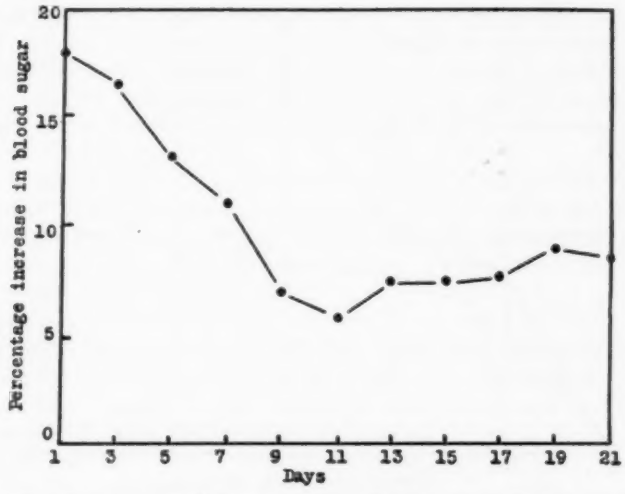
The results of these experiments are shown in graphs I and II. In the first they are plotted to show the increase of blood sugar with the unfiltered radiations and with the radiations filtered by glass. It will be observed that with the filtered radiations the increase soon reaches a



GRAPH I. SHOWING THE INFUENCE OF RADIATIONS, UNFILTERED AND FILTERED THROUGH A GLASS, ON THE BLOOD SUGAR CONCENTRATIONS WITH EXPOSURES OF VARYING LENGTHS IN INCREMENTS OF TEN MINUTES

maximum and remains thus through most of the experiment while the unfiltered radiations cause an increase which progresses more slowly to a much higher maximum and which recedes to a lower value with the 50 and 60 minute irradiation periods. The results of an experiment in which rabbits were exposed on alternate days for equal periods to a Mercury-vapor quartz light are shown in graph II. It is apparent that the animals showed much increase in response to the influence of the light after repeated exposure. The resistance increases until the eleventh day, and from then on decreases until the twenty-first day.

A few incidental things were observed during the investigation. The blood of the animal apparently became considerably thinned after irradiation. When dropping from the ear it was not as viscous following exposure as before exposure. This perhaps bears out Alpern's (1923) results that the water content of the blood increases along with the sugar as result of radiation. It was also observed that animals in which breathing was most pronounced usually showed a little higher sugar value. This is not always the case, however.



GRAPH II. SHOWING THE DECREASE IN THE INFLUENCE OF IRRADIATIONS ON BLOOD SUGAR CONCENTRATIONS WITH 30-MINUTE EXPOSURES GIVEN ON ALTERNATE DAYS

DISCUSSION

The results of this investigation apparently indicate that ultra-violet radiations cause an increase in the sugar concentration of the blood, that with repeated exposure at intervals of two days a resistance to the influence of the radiations is built up, and that this continues for some days thereafter. The interpretation of these results is difficult because it is likely that too few animals were used and it is probable also that other factors are partially responsible for the changes in blood sugar. By giving double exposures first to unfiltered and then to glass filtered

radiation, we have greatly reduced the influence of extraneous factors and by this means are able to separate the influence of emotional factors from direct influence of the ultra-violet. Obviously, some of the light frequencies besides the ultra-violet were lost either through absorption or reflection when glass was interposed between the animal and the light source and it is a just criticism that part of the effect obtained may be the result of the influence of infra red which would be partially absorbed by the glass.

The mechanism whereby ultra-violet produces a greater concentration of blood sugar can not be definitely stated. There are several possible explanations: (*a*) a glycogenolysis produced by extra secretion of adrenalin as a result of nerve stimulation; (*b*) an increase in sugar tolerance; (*c*) a mobilization of glucose from other parts of the body to the blood stream; (*d*) a decrease in insulin either through destruction or through secretory inhibition.

It seems to us that the increased concentration of sugar following irradiation is to be accounted for either by mobilization of glucose from the body into the systematic circulation or by glycogenolysis in the liver. If insulin should be destroyed by the light rays, one would expect the curve showing the increase to constantly progress to a maximum value where it would remain and at which the animal would likely succumb. Sugar would also show a corresponding increase in the urine. Unfortunately, we made no urine analyses. If an increased sugar tolerance should be the explanation it would also seem that the curve should approach a level at which little variation would occur with longer irradiations. Especially one would not expect the curve to indicate a lesser increase such as is shown in graph I following 50 and 60 minute exposures. As glycogenolysis in the liver is known to take place more rapidly and more easily than in muscle the liver would seem to be the more probable source of the sugar increase in the blood following irradiation, although the muscle or even the skin would not be precluded for carbohydrates are known to be stored in them. Perhaps this release of sugar is accomplished by the action of the ultra violet on the sensory nerves which bring about an increased secretion of adrenalin. The adrenalin in turn would stimulate glycogenolysis in the liver. Ultra-violet is known to increase blood pressure. Blood pressure is often followed by an increased blood sugar concentration. This would tend to corroborate the view that the hyperglycemia was due to glycogenolysis.

The mechanism whereby rabbits may increase their resistance to the

effects of ultra violet light is likely similar to the resistance that humans build up during sunburns, namely; an increase in pigmentation. It would be interesting to repeat this experiment on albino rabbits, inasmuch as all of the rabbits used were pigmented individuals.

The blood sugar concentration varied very little after the eleventh day, which apparently represents the time when the maximum amount of pigment has been developed. After that the influence of ultra-violet changed but slightly.

SUMMARY

1. Rabbits irradiated with mercury quartz lights show a decided increase in blood sugar concentration.

2. Radiations from a mercury quartz lamp, when filtered through glass, cause less increase than when the light is unfiltered, indicating that ultra violet has a specific influence on blood sugar concentration.

3. The increased sugar concentration is probably the result of an increased glycogenolysis.

4. Rabbits may develop an increased resistance to the influences of light. This in indicated by the fact that there is less increase in blood sugar after several exposures given on alternate days.

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THE OCCLUSION MEMBRANE IN SNAKES

By Bert Cunningham and M. C. Dunn

Plate 29

Occlusion of the anterior part of the alimentary canal during embryological development is a well known phenomenon. But the formation of a secondary membrane, so far as we have been able to note, has been reported only by Reese.[1] This secondary structure which blocks the pharyngeal region from the oesophagus is called by Reese (1) the occlusion membrane, and persists after the re-opening of the oesophagus.

Among embryonic snakes which we were sectioning we observed these membranes and thought it worth while to confirm the work of Reese.

Our specimens are embryos of *Natrix sipedon*, and were removed from a highly gravid female. The one snake yielding some seventy embryos. They ranged in length from 12 cm. to 13 cm. The embryos contained in one horn appeared in general to be smaller than those of the other.

The specimens with the yolk (fig. 2) were removed and preserved in formalin. They were later separated from the yolk and imbedded in paraffin in the usual manner, and various types of sections made. For the study of the occlusion membrane the sagittal sections (fig. 1) proved more satisfactory than transverse sections in all cases. Three specimens sectioned sagittally showed clearly the occlusion membrane.

In view of the fact that we did not have a variety of embryos as regards to age we were unable to follow the typical occlusion and therefore can not say from our observation that the occlusion membrane is a secondary phenomenon. There is, however, no reason for doubting an earlier occlusion, and the later re-opening of the oesophagus.

In general our observations agree with those of Reese. However, the membrane in our specimen seems to have originated from a tongue of epithelium which juts out from all sides of the pharynx. This is well shown in figure 3. There is not quite so much folding of the mem-

[1] Reese, A. M. The Occlusion of the Oesophagus and Trachea in Crocodilia and Snakes. Amer. Jour. Anat. **37**: 195-212. 1926.

brane in our specimens as Reese found, but there is folding. The membrane seems to completely shut off the oesophagus.

In structure the membrane, for the most part, is 2–3 cells thick (see fig. 4) except at the point of origin where the base spreads out to a broad V shape. The cells contain rather large nuclei and are not like those figured by Reese. We did not observe any of the "curiously irregularly projecting cells."

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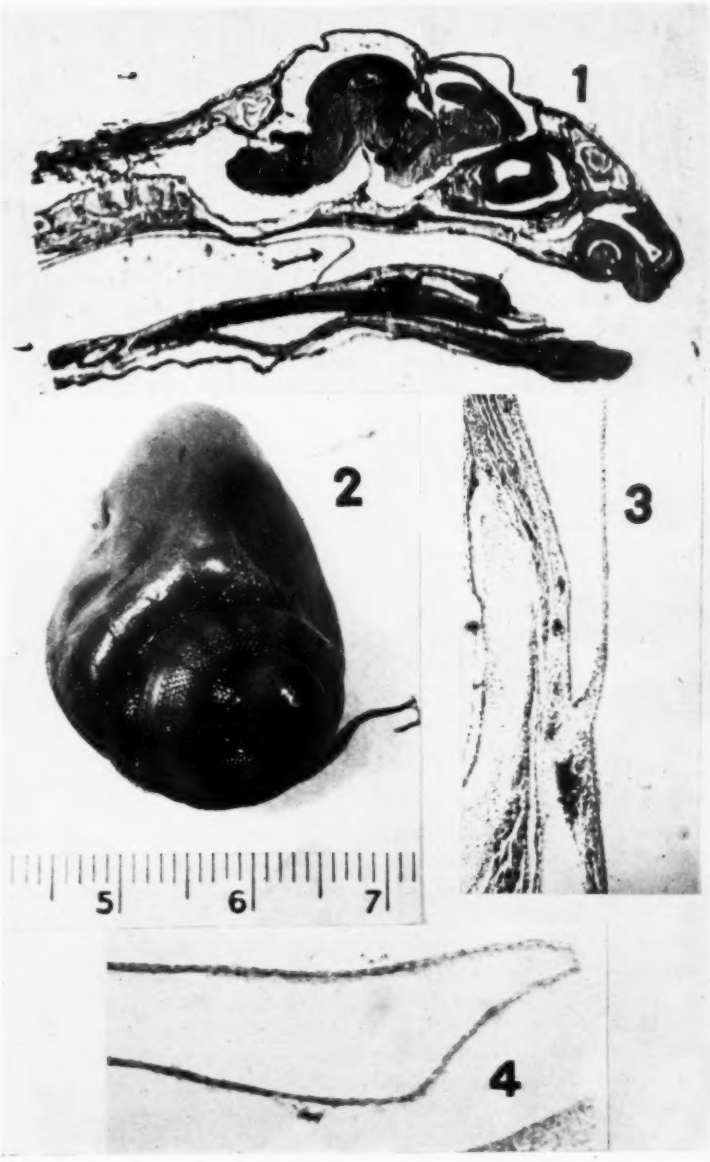
EXPLANATION OF PLATE 29

Fig. 1. Photograph of a sagittal section through the head of an embryo of *Natrix sipedon*. The arrow points to the occlusion membrane.
Fig. 2. Photograph of embryo on the yolk. The scale is in centimeters.
Fig. 3. Photograph showing the epithelial structure of the occlusion membrane.
Fig. 4. Photograph showing the cellular structure, especially the large nuclei.

PLATE 29



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A NEW TREMATODE FROM THE SNAPPING TURTLE

By Dean W. Rumbold

Plate 30

While making examinations from parasites in turtles, the writer found a new species of *Cotylaspis* in the intestine of *Chelydra serpentina* (Linné). The turtle host was collected in a mill race below a dam in the Eno River about five miles west of Durham, N. C.

Cotylaspis belongs to the family Aspidogastridae (*Poche*, 1907), which includes both ectoparasites and endoparasites and occurs in the molluscs, elasmobranchs, fishes and turtles. In crustaceans larvae have been found encysted in the intestine (Cunningham, 1884). Stunkard (1917), following Nickerson (1902), divided the family into six genera: *Aspidogaster* (von Baer, 1827), *Cotylaspis* (Leidy, 1857), *Macraspis* (Olsson, 1868), *Stichocotyle* (Cunningham, 1884), *Cotylogaster* (Monticelli, 1892), and *Lophotaspis* (Looss, 1902).

The genus contains three species: *C. lenoiri* (Poirier, 1866), from the intestine of a turtle, *Tetrathyra vaillanti* from Senegal; *C. insignis* Leidy (1857) in the mantle cavity of the Unionidae of North America, and *C. cokeri* (Barker and Parsons, 1914) Stunkard (1917) from the intestine of *Malacoclemys leseurii* of North America.

Cotylaspis stunkardi n. sp.

Only one specimen was obtained. This was studied alive and then fixed, stained, and mounted. This species is named for Professor H. W. Stunkard on account of his eminent work in the field of parasitology, particularly for his review of the family Aspidogastridae to which it belongs.

The specimen agrees with other species of the genus in having a large ventral adhesive disc, three rows of alveoli, marginal organs, subterminal mouth, no oral sucker, and one testis.

The adhesive disc (fig. 3) is oval, measuring 2.91 mm. in length by 0.9 mm. in width. It is a multiloculate sucker used for attachment and locomotion. It is composed of fifty acetabula arranged on the ventral surface; thirty-four in the two lateral rows and sixteen in a

middle row. Thus there are three rows each containing sixteen acetabula and an additional acetabulum at the anterior and posterior ends. Marginal acetabula give a crenate edge to the whole disc.

The ventral side of the animal is flat while the dorsal side is rounded. The anterior part of the dorsal side extends forward as a neck and may be protruded so that the length of the body is nearly doubled. The integument has neither hooks nor spines.

Alimentary canal. There is no oral sucker, but the mouth funnel is cup shaped and serves as an organ of adhesion. The mouth funnel is subterminal; 0.10 mm. in diameter. It is followed by a spherical muscular pharynx, which is 0.12 mm. in diameter and leads into a short oesophagus which enters the long rhabdocoel gut (figs. 2, 4). The gut extends 0.63 mm. behind the posterior edge of the testis and reaches to within 0.20 mm. of the posterior edge of the disc; width, 0.07 mm. to 0.19 mm.; average about 0.11 mm.

Female reproductive system (figs. 1, 5). The ovary is a fairly large body, nearly square, bilobed on the posterior margin. The ova can be easily seen, in various stages of development. On the lateral margin the ova are small, and their size gradually increases toward the median line, particularly in the postero-median lobe (fig. 5). The ovary measures 0.17 mm. wide by 0.22 mm. in length. It is located on the right side of the body a little anterior to the middle. Immediately posterior to it is a rounded body which is probably the shell gland; 0.17 mm. in diameter. Over the top of this organ, a group of yolk cells (fig. 5) is in the process of forming an egg. Immediately posterior to this mass there is a fully formed egg in the uterus. The convoluted uterus lies just to the left of the median line and contains nineteen large eggs. It continues anteriorly to open to the outside just posterior to the pharynx. It could not be determined whether there was a single genital pore or a double one, as found in sections of *C. insignis* and *C. cokeri* by Stunkard (1917). The eggs measured 0.15 mm. in length by 0.08 mm. in width. The vitellaria (fig. 2) are somewhat more numerous and smaller toward the anterior end of the body. They are arranged in the general form of a U with two rather definite postero-lateral rows. Those in the posterior region averaged 0.08 mm. in length by 0.13 mm. in width; those at the anterior, 0.036 mm. by 0.043 mm. and are less distinct.

Male reproductive system (figs. 2, 5). The testis is a large oval, median organ just posterior to the middle of the body; 0.17 mm. in

length and 0.24 mm. in width. The coiled seminal vesicle is apparent slightly anterior to the ovary. Its tubes are slender, 0.04 mm. in diameter. The coiling is not as pronounced as described for *C. cokeri* by Stunkard (1917). The coils extend anteriorly between the uterus and the middle line, crossing over to the cirrus sac on the right side of the anterior end of the gut. The muscular cirrus sac is large, pyriform, has a curved duct, and opens to the outside near or with the opening of the uterus; length 0.21 mm., width 0.11 mm.

Marginal organs (fig. 3). A marginal organ is found in each ridge between the alveoli. These structures have been reported as secretory, but Stunkard (1917) shows that they are sensory.

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EXPLANATION OF PLATE 30

COTYLASPIS STUNKARDI

All figures were drawn from the permanent mount with the aid of a camera lucida.

Abbreviations used

cs, cirrus sac
i, intestine
mo, marginal organ
o, ovary
ov, egg
sg, shell gland
sv, seminal vesicle
t, testis
u, uterus
v, vitelline glands
vm, mass of yolk cells rounding into an egg

Fig. 1. Dorsal view. × 27.
Fig. 2. Dorsal view showing vitellaria. × 27.
Fig. 3. Ventral view showing multilocular sucker and marginal organs. × 27.
Fig. 4. Dorsal view showing rhabdocoel intestine. × 27.
Fig. 5. Enlarged view of male and female reproductive systems showing a mass of yolk being rounded into an egg. × 100.

PLATE 30

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SOME NEW WASPS (HYMENOPTERA) AND TWO NEW DIPTERA FROM NORTH CAROLINA

By C. S. Brimley

In an attempt to work up the Spider Wasps or *Psammocharidae* of North Carolina, several apparently new species were discovered in our collections and it seemed best to describe them before publishing the full paper. To these are added two species of another family of wasps (*Cerceridae*) which also appear to be undescribed.

Mr. J. C. Crawford of this division has gone over all the descriptions with me, checking them up with the specimens described and I am very much obliged to him for his help in this and other matters connected with the descriptions.

The types of these new species will be retained for the present in the Entomological Collection of the North Carolina Department of Agriculture.

Family Cerceridae

Cerceris crawfordi n. sp.

Male. Black with the following yellow, face, scape beneath, minute spot on each side of pronotum, tegulae, postscutellum, narrow subequal bands, slightly widened on sides on dorsal abdominal segments 2–6, and transversely elongate lateral spots on ventrals 2–4; flagellum ochraceous beneath. Legs mainly yellow, the following black or blackish, front coxae, base of mid coxae, and extreme base hind coxae, outer side of front femora except at apex, spot at base of mid femora on upper side, apical third of hind femora not reaching extreme apex, and apical third of hind tibiae on upper side; hind tarsi darkened except on basal two thirds of first joint. Wings somewhat darkened, more so towards the costa, stigma yellow.

Head and thorax coarsely punctate, abdomen less coarsely and more sparsely so; clypeus strongly convex with three black teeth on lower edge, hair lobes about three times their length apart; enclosure longitudinally but not very regularly striate; hind tibiae with five spines on the outer edge. Length 9 mm.

In Banks' key to eastern *Cerceris*, runs to couplet 23, but not satisfactorily any further. From the species that couplet leads to it differs from all but *nigrescens* in having the yellow bands on the abdomen subequal instead of having a much broader band on the second segment, from *nigrescens* it differs in having yellow and not whitish markings and in coarser punctuation.

Type. Raleigh, N. C., June 23, 1923, T. B. Mitchell.

Named for Mr. J. C. Crawford of this division.

Cerceris shermani n. sp.

Female. Clypeal process short and broad, emarginate in front, lower margin of clypeus broadly and deeply emarginate; enclosure coarsely and regularly longitudinally striate on its whole surface; head and thorax coarsely and rather closely punctate, punctures of abdomen somewhat finer and sparser.

Black with the following yellow, spot below clypeal process, spot on upper surface of same, spot at base of mandibles, sides of face broadly, scape beneath, spot on each side of pronotum, tegulae, post-scutellum, small spot on each side of first abdominal segment, broad band, emarginate in front, on base of second, narrow bands successively broader on segments 3–5, these broadening on the sides, the one on 3 very attenuate medially. Legs reddish yellow with the following black, all coxae and trochanters, front femora except at apex, mid femora except stripe on front side and apex, hind femora on inner side and base; hind tarsi darkened. Basal joints of flagellum reddish testaceous beneath. Length 11 mm.

Type, female, Raleigh, N. C., mid October, 1917, J. E. Eckert. Paratypes, female, Raleigh, N. C., Sep. 14, 1927, C. S. Brimley; female, Raleigh, N. C., Oct. 2, 1924, C. S. Brimley (this last with much larger yellow spots on first segment), and lastly a female from Laurinburg, N. C., Oct. 11, 1920, T. B. Mitchell, which agrees structurally but has considerably more yellow markings, including two spots behind each eye, an intern-antennal stripe, a large spot each side of propodeum, large spots nearly coalescing on first abdominal segment, the second nearly all yellow above, also a spot on hind coxae and more yellow on the legs. Named for Professor Franklin Sherman, now State Entomologist of South Carolina, for many years Chief of this Division.

In Banks' key to eastern *Cerceris* (Ann. Ent. Soc. Am. **5**: 12. 1912) this species runs to *nigrescens* Sm. from which it differs in having the

markings yellow and not white as in that species, in having the hind legs partly yellow (wholly black in *nigrescens*) and in having the body coarsely punctate.

Family PSAMMOCHARIDAE

Ceropales hatoda n. sp.

Male. Black with the following ivory-white, clypeus, except median stripe not reaching apex, anterior orbits not nearly reaching vertex, posterior orbits interrupted medially, v-shaped spot above base of antennae, spot on scape beneath, spot on second antennal segment beneath, posterior margin of pronotum, spot above front coxae, dot on scutellum, short band on post-scutellum, spot on each side propodeum at tip, apical half fore coxae in front, apices of four posterior coxae, small transverse lateral spots emarginate in front on apices of first four abdominal segments, a short stripe on each side of sixth, and seventh wholly. Coxae except as stated, trochanters, and femora except spot at apex, black; anterior tibiae testaceous with a dark line above, mid tibiae brown, four anterior tarsi testaceous, somewhat darkened at tips, hind tibiae and tarsi dark brown unmarked. Propodeum with a deeply impressed triangle at base. Length 5 mm.

Type, male, Raleigh, N. C., Sep. 9, 1925, C. S. Brimley.

In Fox's key to the genus (Trans. Am. Ent. Soc., **19**: 49. 1892) this species runs to *longipes* Cr., from which it may be distinguished by the smaller size, dark labrum, unspotted mesopleura, unicolorous hind tarsi and different abdominal markings. It is still nearer *foxii* Rohwer (1916), but differs in the dark, not reddish femora.

Ageniella aludra n. sp.

Black, except apical half of hind femora which are reddish. Wings subhyaline, second cubital slightly longer than broad, third cubital considerably broader than long, very short, neither much narrowed above, the third receiving second recurrent before middle. Head and thorax with grayish pile; propodeum granulate with a faint median longitudinal furrow, abdomen shining. Length 5 mm.

Type, male, Raleigh, N. C., May 18, 1926, C. S. Brimley; paratype male, same locality, taken just a year later, May 18, 1927, differs only in having the red of the hind femora confined to the underside of the apical half.

In Banks' key to the genus (Jour. N. Y. Ent. Soc. **19**: 234. 1911) this species runs to couplet 13, but differs from the two species in that

couplet by having the wings subhyaline, instead of blackish as in *atrata* Prov. or with faint clouds as in *brevis* Cr., and from the latter also by having the tarsi dark.

Ageniella mintaka n. sp.

Black, tip of abdomen and spurs of four anterior tibiae white, spurs of posterior pair black. Wings subhyaline darkened at tip, the two cubital cells subequal in size, about one and one half times as long on the cubital vein as broad, the third a little the longer, its outer side sharply angled a little below the middle and with a short external spur at the angle; third cubital receiving second recurrent at apical two-thirds, nervulus interstitial with basal vein in forewings. Length 4 mm.

Type, male, Raleigh, N. C., June 9, 1927, C. S. Brimley.

In Banks' key runs to couplet 11, but differs from *iridipennis* Cr. in having the basal veins of the forewings interstitial, from *virginicus* Bks. by having a white spot at the tip of the abdomen, and from both by the subhyaline wings and the outwardly angled third cubital.

Pseudagenia marionae n. sp.

Male. Black, the following white, mandibles except tips, face below antennal base, ascending some distance higher on sides, spot on under side of scape, posterior margin of pronotum, tubercle, lower margin of pronotum, tegulae, and spot at tip of abdomen. Legs including coxae, and first two abdominal segments except base of first and apex of second above, reddish testaceous; first three joints of hind tarsi tipped with blackish, last two mostly dark, the other tarsi darkened at tip, palpi pale. Hair and pile whitish, abundant and erect on propodeum. Wings subhyaline, both cubitals long, the third the largest receiving second recurrent at about inner third. Length 7 mm.

Type, Raleigh, N. C., mid May, 1921, T. B. Mitchell.

Looks somewhat like male *mellipes* Say, but the wholly pale coxae, the white markings on pronotum, and the reddish base to the abdomen will sufficiently distinguish it. The face markings also are whiter, those of *mellipes* being tinged with yellow.

Pseudagenia mariva n. sp.

Male. Black, shining, with abundant black hair on head, pronotum and underparts, that of upper parts mainly whitish except on apical half of abdomen where it is mainly black. Lateral ocelli nearer to each

other than to the eyes; a fine, faintly impressed line from anterior ocellus about two thirds the distance to base of antennae; clypeus truncate below; pronotum subangulate behind; propodeum entirely without a longitudinal furrow. Wings subhyaline, darkened at tips; second cubital slightly longer than broad, its inner side rounded, receiving first recurrent about middle, third cubital about one and one-half times as long on the cubital vein as broad, receiving second recurrent slightly before middle, its outer side rounded, neither cell much narrowed above; nervellus slightly before cubitus in hind wings, nervulus much beyond basal vein in fore wings. Length 10 mm.

Type, male, Linville Falls, N. C., late June, 1920, F. Sherman.

Seems nearest *nigripilosa* Cresson, but differs in the absence of any furrow on the propodeum and in the third cubital receiving the second recurrent near the middle instead of near the base.

Pseudagenia najacra n. sp.

Male. Black with rather abundant grayish hair, thickest on head and thorax, only the long hairs on the vertex being brownish; anterior knees reddish testaceous, the anterior tibiae also reddish testaceous at apex, base and on inner side. Lateral ocelli equidistant from each other and from the eyes; pronotum arcuate behind; propodeum with faint longitudinal median furrow; longer spur of hind tibiae almost as long as the metatarsus. Head subshining, thorax opaque, propodeum and abdomen shining. Wings subhyaline, darker at tips; second cubital as broad as long, receiving first recurrent beyond middle, third cubital about one and one-half times as long on the cubital vein as broad, receiving second recurrent slightly before middle, neither cell much narrowed above; nervellus interstitial with cubitus in hind wings. Length 7 mm.

Type, male, Raleigh, N. C., June 29, 1926, C. S. Brimley.

Seems nearest *albopilosus* Cr. but pronotum is arcuate instead of angulate, and third cubital receives second recurrent near middle and not near base.

Priocnemis leibyi n. sp.

Black, clypeus, except a median apical spot, anterior orbits to about level of anterior ocellus, posterior orbits, basal half of mandibles, anterior coxae in front, stripe on front side of anterior tibiae, front tarsi except fourth joint, first and second joints of mid tarsi except apices

which are black, and seventh abdominal segment except apical black triangle, all white or ivory white. Narrow stripe on scape beneath, apex of anterior trochanters, anterior tibiae except the white stripe, all the other tibiae and all femora reddish testaceous; fourth joint anterior tarsi, apical joints of mid tarsi, all of hind tarsi, extreme base hind femora, and extreme base and apex of hind tibiae, blackish. Hind tibiae with short spines on outer side. Wings subhyaline, darkened at tips, and with a rather faint cloud on second transverse cubital and on adjoining portion of second discoidal cell. Second cubital about twice as long as broad, third about three times as long as broad at base, the veins at inner end of second and outer end of third cubitals very oblique so that these cells are much longer on the cubital than on the radial vein. Stigma pale in the center. Nervellus in hind wing slightly beyond cubitus. Length 10 mm.

Type, male, Edgecombe Co., N. C., June 24, 1927, C. S. Brimley. A paratype male, Raleigh, N. C., June 14, 1927, C. S. B., has a dark stripe on the basal half of the inner side of the anterior femora, the third joint of the mid tarsi is light at base, and the second joint of the hind tarsi is partly yellow, otherwise like the type.

Agrees with *pulchrina* Cr. (described in *Agenia*) but differs in having the legs mainly reddish instead of black as in that species. Named for Dr. R. W. Leiby, Chief of the Entomology Division of the North Carolina Department of Agriculture.

Pompiloides agnema n. sp.

Black, the pronotum white margined behind, the second dorsal abdominal segment with a red spot on each side, and the seventh segment paler at apex with dense silvery prostrate hair; body with dense silvery pile, especially on prothorax, pleurae, coxae, first abdominal segment and basal half of second; clypeus, face below antennae and anterior orbits to some distance above antennal base with dense prostrate white hair. Pronotum angulate behind; propodeum with a median longitudinal impressed line. Wings subhyaline, darkened at tips, third cubital cell short petiolate. Length 8½ mm.

Type, male, Raleigh, N. C., July 23, 1924, C. S. Brimley.

Near *albomarginatus* Bks., but differs in the red spots on the second abdominal segment, in the silvery pubescence of the first and second abdominal segments, and by the silvery white, not merely white or gray hair on the seventh segment above.

DIPTERA

Ommatius gemma n. sp. (*Asilidae*)

Male. Smaller than *marginellus* with the costa less dilated and with apical three fourths of forceps slender, attenuated, and tapering to a sharp point, nearly straight beyond base at which it is bent inward at an angle of 135 degrees towards its fellow on the other side (in *marginellus* broad and rounded at tip). Scutellum with scattered short hairs and in addition with two long upturned bristle like hairs at apex (in *marginellus* with the hairs all long and none differentiated from the others). Legs yellow, more or less blackened at tips of femora and tibiae, the hind femora black for about apical fifth; pleura light gray, pollinose; otherwise much as in *marginellus*. Length 9–10 mm.

Type, male, Raleigh, N. C., Aug. 3, 1927; paratypes, two males, same locality, June 23, 1925, July 8, 1926, all collected by myself.

Belvosia orion n. sp. (*Tachinidae*)

Runs in Curran's recent key to the genus *Belvosia* to *splendens* Curran, but differs in having from four to six marginal macrochaetae on each of the first two abdominal segments instead of only a single pair on each.

Male. Blackish, grayish pruinose on the humeri but not elsewhere, last two abdominal segments densely golden pollinose except at the apices which are black; sides of face and front silvery pollinose, frontal vitta brownish black, broader than parafrontals; palpi black, reddish at tip; wings uniformly fuscous, darker towards the costa; calypteres dark brown. Facial ridges with nine bristles above the vibrissae on one side and twelve on the other, and with one or two bristles and several hairs on each side outside of these; about twenty frontal bristles in two rows on each side, and a large reclinate bristle behind them; both verticals well developed. Sternopleurals seven on one side, six on the other; scutellum with twelve marginals; first abdominal segment with six marginals, second with four; third with a row completely encircling it above and below, about 18 of them being on the dorsum, fourth with an encircling row. Length 18 mm. Type, Raleigh, N. C., bred from pupa of *Ceratomia undulosa*, May 15, 1918, C. S. Brimley.

Female. Similar to male but with proclinate orbitals, three on one side, four on the other; about eight bristles above vibrissae on each side; about eighteen bristles each side on the parafrontals; five marginals

each on the first and second abdominal segments; frontal vitta same width as parafrontals. Length 19 mm. Allotype female, Raleigh, N. C., June, C. S. Brimley.

The types of these two species will be deposited in the U. S. National Museum, the paratypes retained in the Collection of the N. C. Department of Agriculture.

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THE POUND AS COMPARED WITH THE "SLUG" AS A UNIT OF MASS

By T. F. Hickerson

Newton's Second Law of Motion, as ordinarily interpreted, states that a body when acted upon by an unbalanced external force will be *accelerated* in the direction of the force by an amount which is directly proportional to the *force* and inversely proportional to the *Mass* (or inertia) of the body. That is,

$$F = K M a \tag{1}$$

Where F = Force.
K = A constant.
M = Mass.
a = Acceleration.

It is a well established fact that the *pull of the earth* on bodies of various masses is a *force* (called weight, W) which, acting alone, will produce an acceleration of g units per second^2 (in a vacuum). Hence substituting in equation (1), we have:

$$W = K M g \tag{2}$$

In dividing equation (1) by equation (2), the quantities M and K are eliminated, and the result is

$$\frac{F}{W} = \frac{a}{g}$$

or

$$F = \frac{W}{g} a \tag{3}$$

Formula (3) is widely used by engineers in the solution of problems in kinetics where the motion is that of translation. It holds true regardless of whatever unit may be chosen for M, the mass. In fact, mass is not mentioned in formula (3).

In each of the three established systems of units given in table 1,

the constant K purposely becomes *unity*. Newton's Second Law of Motion in terms of these units is as follows:

(1) *International:* A force of 1 dyne acting on a mass of 1 gram produces an acceleration of 1 centimeter per second.[2]

(2) *British:* A force of 1 poundal acting on a mass of 1 pound produces an acceleration of 1 foot per second.[2]

TABLE 1

MECHANICAL UNITS

SYSTEMS OF UNITS	UNITS IN EACH SYSTEM			
	Length	Time	Mass	Force
International or Centimeter-gram-second (C. G. S.) g = 981 nearly	*Centimeter*	*Second*	*Gram*	*Dyne* $= \frac{1}{g}$ of a gm. wt.
British or Foot-pound-second (F. P. S.) g = 32.2 nearly	*Foot*	*Second*	*Pound*	*Poundal* $= \frac{1}{g}$ of a lb. wt.
British Engineers' or Foot-slug-second (F. S. S.) g_e' = 32.1912	*Foot*	*Second*	*Slug*	*Pound* = Weight of a pound mass at London and at sea level. 1 lb. wt. = g_e' poundals
Proposed Engineers' or Foot-pound-second (F. P. S.) g_e = 32.1740	*Foot*	*Second*	*Pound*	*Pound* = Weight of a pound mass at 45° north latitude and at sea level.

(3) *British Engineers:* A force of 1 pound acting on a mass of 1 slug produces an acceleration of 1 foot per second.[2]

Of these systems, the C. G. S. was fixed by an International Conference at Paris in 1875. In the British System, often referred to as the *British Absolute*, the pound is the unit of mass and the unit of force

is called *poundal*, a term suggested by the late Professor James Thompson. In the British Engineers' system, the pound weight at sea level in London is taken as the unit force, the unit mass being 32.1912 pounds, for which the term *slug* was suggested by Professor A. M. Worthington.

According to the modified Engineers' System of units, which the writer proposes, Newton's Law reads as follows: A force of 1 pound acting on a mass of 1 pound produces an acceleration of g_o feet per second.[2] (See formula (5).)

On comparing formulas (1) and (3), it follows that

$$K M = \frac{W}{g}$$

and

$$M = \frac{1}{K}\frac{W}{g} \tag{4}$$

Of the quantities mentioned in equation (4), M and K are constants, but W and g vary slightly at different places on the earth; the ratio $\frac{W}{g}$, however, remains invariable.

TABLE 2

VALUES OF g

	IN FOOT-POUND-SECS.	IN CM. GM. SECS.
The Equator	32.091	978.10
London	32.191	981.17
45°N. Latitude	32.174	980.665
The Pole	32.255	983.11

The weight of a body is the force that gravity exerts on that body. It depends (1) on the mass of the body; (2) on the acceleration of gravity (g), which varies inversely as the square of the distance from the mass-center of the earth; hence the weight of a body depends upon its position as regards the center of the earth. The distance, however, of all inhabited places on the earth from the center is so nearly constant, that for all practical purposes we may assume that the acceleration of gravity is constant (the extreme variation—see table 2—is about one-third of one per cent). Consequently for practical purposes we *compare masses by their weights*, although they have different meanings.

At 45° north latitude and at sea level, it is known that the acceleration (g_o, say) of a falling body (in a vacuum) is 32.1740 feet per second per second, or for all practical purposes, it is 32.2 feet per second.[2]

Consider now a certain carefully preserved lump of metal whose *mass* may be called *one pound*. As compared on an equal-arm balance scale, one pound is 0.453592477 of the standard Kilogram. Let the *force* required to support (that is, prevent from falling) this lump of metal, in vacuo, and in the standard locality (at 45° north latitude and at sea level) be also called *one pound*.

Hence, we may assume the weight or earth pull of bodies at 45° north latitude and at sea level to be identical with their invariable masses, the units of mass and weight each being the well known pound.

Accordingly, at 45° north latitude the quantities M and W of equation (4) will cancel, and we shall have

$$1 = \frac{1}{K}\frac{1}{g_o},$$

or

$$K = \frac{1}{g_o} = \frac{1}{32.2} \text{ closely.}$$

Hence formula (1) becomes

$$F = M\frac{a}{g_o} = M\frac{a}{32.2} \text{ (closely)} \tag{5}$$

Substituting the value of K in equation (4), and solving for W, gives

$$W = \frac{g}{g_o}M = \frac{g}{32.174}M \tag{6}$$

Equation (6) gives precisely the weight (or earth pull) of bodies at any place on the earth's surface; it also gives the *planet pull* of a body on Mars or any other planet. If we imagine a body on the surface of some isolated planet twice as dense and of the same size as the earth, then its weight would be twice its weight at 45° N. latitude, the mass remaining unchanged. Formula (6) shows this to be the case, since the value of g would be double its value on the earth.

Evidently the values of g vary so slightly at different positions on the *earth's surface* that the average value of g ($= g_o = 32.2$) will be sufficiently close for all practical purposes. Hence, we have

$$W = M \text{ (closely)}$$

TABLE 3

THE POUND AS COMPARED WITH THE SLUG AS A UNIT OF MASS

	SYSTEMS OF UNITS	
	(1) Foot-Slug-Second	(2) Foot-Pound-Second
Mass	$= M = \frac{W}{g}$	$= M = \frac{g_o}{g} W = W$ (closely)
Moment of Inertia	$= I = \int x^2 dM$ = Slug − ft².	$= I = \int x^2 dM$ = Pound − ft².
Radius of Gyration	$= r = \sqrt{\frac{I}{M}}$ = Same for both cases.	
Moment of Inertia	$= I = Mr^2 = \frac{W}{g} r^2$	$= I = \frac{Mr^2}{g_o} = \frac{W}{g} r^2$
Translation	$F = Ma = \frac{W}{g} a$	$F = M\frac{a}{g_o} = W\frac{a}{g}$
Rotation	$T = I\alpha = Mr^2\alpha = \frac{W}{g} r^2\alpha$. where α is the angular acceleration produced by a torque T on a body whose moment of inertia is I in slug − ft² units.	$T = \frac{I\alpha}{g_o} = \frac{Mr^2\alpha}{g_o} = \frac{W}{g} r^2\alpha$. where α is the angular acceleration produced by a torque T on a body whose moment of inertia is I in pound − ft² units.
Kinetic Energy (translation)	$= \frac{1}{2}Mv^2 = \frac{1}{2}\frac{W}{g} v^2$	$= \frac{1}{2}\frac{Mv^2}{g_o} = \frac{1}{2}\frac{W}{g} v^2$
Kinetic Energy (rotation)	$= \frac{1}{2}I\omega^2 = \frac{1}{2}Mr^2\omega^2 = \frac{1}{2}\frac{W}{g} r^2\omega^2$ where ω is the angular velocity in radians per sec., and I is the moment of inertia in slug-ft² units.	$= \frac{1}{2}\frac{I\omega^2}{g_o} = \frac{1}{2}\frac{Mr^2\omega^2}{g_o} = \frac{1}{2}\frac{W}{g} r^2\omega^2$. where ω is the angular velocity in radians per sec., and I is the moment of inertia in pound-feet² units.
Potential Energy (translation)	$= Mgh = Wh$	$= Mh = Wh$
Linear Momentum	$= Mv = \frac{W}{g} v$	$= \frac{Mv}{g_o} = \frac{W}{g} v$
Angular Momentum	$= I\omega = Mr^2\omega = \frac{W}{g} r^2\omega$. I being in slug-ft². units	$= \frac{I\omega}{g_o} = \frac{Mr^2\omega}{g_o} = \frac{W}{g} r^2\omega$. I being in pound-ft². units.
Linear Impulse	$= \int F dt$ = Pound-secs.	= Same for both cases.
Angular Impulse	$= \int T dt$ = Foot-Pound-secs.	= Same for both cases.
Work (translation)	$= \int F ds$ = Foot-Pounds	= Same for both cases.
Work (rotation)	$= \int T d\theta$ = Foot-pounds	= Same for both cases.

That is, the weight and mass of bodies may be regarded as *identical*, each being expressed in *pounds*. This statement is everywhere exactly true when a body is "weighed" by means of a *balance* scale (as is customary in commerce) instead of a *spring* balance.

On the basis of the "slug" as a unit of mass, equation (1), to be dimensionally correct, reads:

$$F = K\,M\,a = \left(\frac{W}{g}\right) a, \text{ that is;}$$

$$F\ (\text{Pounds}) = \frac{W\ (\text{Pounds})}{g\ (\text{Ft./sec}^2)} \times a\ (\text{Ft./sec}^2)$$

Hence, we have

$$Mass = \frac{Pounds}{Ft./sec^2}$$

This expression is difficult to visualize or interpret as a physical quantity, since it fails to appeal to common experience.

On the basis of the pound as a unit of mass, equation (1) is dimensionally correct, and it reads:

$$F = K\,M\,a = (W)\,\frac{a}{g}, \text{ that is;}$$

$$F\ (\text{Pounds}) = W\ (\text{Pounds}) \times \frac{a\ (\text{Ft./sec}^2)}{g\ (\text{Ft./sec}^2)}$$

Hence, we have

$$Mass = Pounds$$

This statement appeals to our common experience as being correct.

Hence the vague idea of a *slug* (32.2 lbs.), the unit of mass presented in texts on Engineering Mechanics, might be entirely abandoned; thus simplifying the subject to a considerable extent, in the writer's opinion.

Table 3 shows by comparison how typical quantities and expressions would be represented on the basis of (1) the *slug* and (2) the *pound* as the unit of mass.

REMARKS ON TABLE 3

It should be noted that in every case the final working formula in terms of the weight of the body is exactly the same regardless of whether

the slug or the pound is the standard unit of mass. The only exception to this statement is of course the expression for mass itself, which is $\frac{W}{g}$ for Case (1) and W for Case (2).

The moment of inertia of solids is expressed in the familiar pound-ft.^{2} units for Case (2) as against the unfamiliar slug-ft.^{2} units for Case (1).

According to the pound standard, momentum is defined as *proportional* to *mass* $\times$ *velocity* instead of *equal* to *mass* $\times$ *velocity*. Likewise, kinetic energy is defined as being *proportional* to $\frac{1}{2}$(*mass*) $\times v^2$ instead of being *equal* to $\frac{1}{2}$(*mass*) $\times v^2$. The expression for potential energy, however, is simplified in being Mh instead of Mgh.

CONCLUSIONS

The final result of any problem in kinetics will be exactly the *same* whether we use the slug or the pound as a standard. The slug, however, is a unit that is not met with in every day life, and hence its use in *mechanics* tends to confuse and mystify the student. The weight of one slug is nearly 32.2 pounds. The burden of carrying a slug in one's pocket instead of a pound just about expresses the relative burden on the average student's mind in trying to think in terms of slug units instead of pound units!

In conclusion the writer wishes to hereby enter a plea for the adoption of the pound instead of the slug as the unit of mass, as well as the unit of force.

Furthermore, instead of the *dyne*, the *gram* would be proposed as the unit of force as well as the unit of mass, if the metric system were generally adopted.

ESTIMATION OF NICKEL IN STEELS[1]

By C. L. Thomas

In the past considerable trouble has been experienced in the determination of nickel in steels by the dimethyl-glyoxime method. The separation of nickel from the other constituents in iron and steel by the above method is effected by holding the other elements present in solution by means of tartaric acid, while the dimethyl glyoxime is added and the solution made alkaline with ammonium hydroxide to precipitate the nickel as nickel dimethyl glyoximate. The theory of the method seems to be sound, the difficulty being that when the dimethyl glyoxime is added and the solution made alkaline instead of precipitating the brilliant red nickel compound the whole solution becomes colored, usually a shade of deep red and the nickel dimethyl glyoximate remains in this colored suspension. So far the cause of the formation of this suspension rather than a precipitate has not been determined, however from observations during this investigation it seems probable that it is due to the relatively large portion of alcohol added as a solvent for the dimethyl glyoxime. This is further aggravated by the addition of another portion of dimethyl glyoxime when the initial quantity does not cause precipitation.

In the hope of overcoming these difficulties the following scheme of analysis was devised. The sample of steel (about 1 gram) is dissolved in 20 cc. of 1:1 concentrated nitric acid and water, the solution is usually rapid, however with certain steels there is a slight residue which seems to resist solution. This may be gotten in solution by the addition of a few drops of concentrated hydrochloric acid. The solution is then boiled gently until there remains only about 5 cc. This is done to remove any oxides of nitrogen and to boil off the excess of nitric acid. Ten cubic centimeters of distilled water are then added and 25 cc. of concentrated ammonium hydroxide added with care to prevent any sputtering and loss of material. This mixture is then boiled and the precipitate of ferric hydroxide filtered off and washed with three 10 cc. portions of hot ammonium hydroxide. (A Buchner funnel and vacuum filter can be used to advantage in this filtration with excellent results since the concentration of nickel in the filtrate is very small and the loss

[1] Read at the North Carolina Section of the American Chemical Society at Davidson, N. C., May 1927.

consequently small.) The filtrate is then boiled to remove the excess ammonia and 5 cc. of a 3 per cent solution of dimethyl glyoxime in acetone added, after the solution has cooled to room temperature. The precipitate usually forms immediately but in some cases a yellowish solution is formed, the precipitate can be made to form from this by vigorously stirring the solution and gently warming. The precipitate is then filtered off, dried and weighed on a Gooch crucible as usual.

The method differs from the old method essentially in that the nickel and iron are separated by taking advantage of the formation of a soluble complex nickel ammonium salt while under the same conditions the iron forms no such salt, thus the nickel is separated from the iron before precipitating it rather than trying to precipitate it while the iron is held in an unstable solution.

Bureau of Standard samples were used in these studies. In the following table a comparison is given between the analytical results obtained and the analyses reported by the Bureau of Standards.

SAMPLE NUMBER	WEIGHT OF SAMPLE	PER CENT Ni FOUND	AVERAGE PER CENT	BUREAU OF STANDARDS PER CENT
	grams			
1 a	2	0.032		
1 b	2	0.044		
1 c	2	0.039		
1 d	1	0.035	0.0377	0.044
2 a	3	0.0067		
2 b	3	0.0074	0.007	0.006
3 a	1	0.122		
3 b	1	0.112	0.117	0.110
4 a	1	0.152		
4 b	1	0.154	0.153	0.196
5 a, b, c, and d. This sample was not reported since under no conditions was a precipitate obtained. See discussion.				0.002
6 a	1	0.077		
6 b	1	0.075	0.076	0.074
7 a	1	1.20		
7 b	1	1.11	1.155	3.21
9 a	1	0.0023		
9 b	1	0.0058		
9 c	1	0.0014	0.0032	0.0041

Sample no. 5 contained besides 0.002 per cent Ni, manganese, phosphorus, sulphur, silicon, copper, chromium, vanadium, molybdenum, and arsenic. Thus it is concluded that the method is worthless for highly alloyed steels containing only a small per cent of nickel. In fact interference would be expected in such a large number of elements with such a small amount of nickel.

Sample no. 7 contained such a large amount of nickel that it is very probable that a large part of the nickel was adsorbed by the ferric hydroxide thus causing the large error shown. Fortunately the old method works nicely for samples containing over 1 per cent nickel and they form a precipitate readily, however it was thought advisable to find out the limits of the method and this sample shows that the upper percentage limit is certainly below 3 per cent nickel.

From these data it is concluded that under the conditions given a sufficient quantity of the nickel ammonium complex can be washed out from the ferric hydroxide to make the separation quantitative enough for technical analyses provided the per cent nickel present is small and the steel is not highly alloyed.

I take this opportunity to thank Dr. F. C. Vilbrandt for his kind cooperation in furnishing the steel samples and offering valuable suggestions from time to time during the investigation.

SUMMARY

A method has been devised for the determination of small amounts of nickel in steel which will work every time.

The method has been tested and found to check favorably with the results obtained by the Bureau of Standards provided the per cent of nickel is below 1 per cent.

UNIVERSITY OF NORTH CAROLINA,
CHAPEL HILL, N. C.

THE DEVELOPMENT OF PEACH SOOTY MOLD AT NORMAL AND LOW TEMPERATURES

By G. W. Fant

Plates 31, 32

During the summer of 1925, specimens of sooty mold stained peaches grown in the vicinity of Aberdeen, North Carolina, and shipped at refrigerated temperatures to northern markets, were received for examination by the writer at the Plant Pathology Laboratory of North Carolina State College. The stain which was superficial in occurrence adhered closely to the surface of otherwise sound fruit, on which account it could be removed only slightly by vigorous rubbing with the hands. Microscopical examination of stain material scraped from affected fruit revealed that the discoloration consisted of olivaceous thick-walled fungous hyphae, which produced when transferred to culture media, rapidly growing colonies of scant hyaline mycelia, from which an abundance of budding conidia were produced. Cultural studies undertaken in which the organism was grown on dextrose-peptone agar, extracted peach juice, sterilized peach pulp, and moistened filter paper made it appear that the organism thus isolated was in agreement with those of the *Fumago* group, recorded as occurring on the surface of plant parts of a number of different plants, as well as producing a sooty mold of the fruit of citrus and other fruit crops. Stain production recorded in the following both by this fungus and those of indistinguishable strains isolated from the bark of healthy peach twigs on several occasions at Raleigh, N. C., made it appear further that the organism employed in the writer's experiments was the saprophytic sooty mold fungus *Fumago vagans* Pers. In addition to the staining of citrus fruits, a surface blemish of the apple produced by this fungus has been reported in recent years.[1]

In cultures grown by the writer on dextrose-peptone agar, budding spores were produced in large numbers, while fungous hyphae, which with few exceptions were hyaline, could be located only with difficulty. Hyphae where observed in the case of young colonies, and also those

[1] The Plant Disease Reporter 11, No. 8: 91. 1927.

observed in marginal areas of older colonies, bore from few to many conidia, which in turn gave rise to secondary conidia by budding (pl. 32, fig. 4). By the process of conidial formation and subsequent budding, spore masses consisting of large numbers of spores were produced in the proximity of individual hyphae, with the result that colonies grown on nutrient agar consisted largely of budding spores.

In contrast with the scant mycelial growth produced on nutrient agar, extensive development of olivaceous thick-walled hyphae occurred where pieces of moist filter paper were inoculated, and subjected, in a manner similar to the inoculated fruit described in subsequent paragraphs, to low temperatures for several weeks (pl. 31, fig. 5). Thick-walled hyphae which developed in this manner showed no tendency toward sporulation.

Following the isolations, inoculation experiments were undertaken, using the strain isolated from the originally stained fruit and also strains isolated from peach twigs at Raleigh, N. C. In these experiments stain production both at laboratory temperatures and those of refrigeration were studied, because of the possible development of the stain at refrigerated temperatures in storage or during refrigerated shipment. Two series of inoculation trials were accordingly undertaken, one in which inoculated fruit placed in moist chambers was kept at laboratory temperatures, and another in which inoculated fruit, similarly placed in moist chambers, was stored in cold storage rooms having a temperature variant of from 0° to 10° centigrade. Moisture laden atmosphere was maintained within the inoculation chambers by means of small beakers filled with water and placed within the containers.

In each series, both fruit inoculated directly and fruit inoculated following the application of extracted peach juice was included in the inoculation trials, and also uninoculated checks receiving no treatment. A water suspension of conidia grown on nutrient agar served as inoculum in all instances. Four moist chambers containing three peaches each were included in each series. These experiments conducted in June of 1926 were duplicated by an additional set of experiments in August of the same year.

As a result of the inoculation trials in both series, pronounced sooty mold stain was induced to develop at both low and high temperatures. Stain development took place at a much faster rate at the higher temperatures, although it was necessary to exercise care at laboratory temperatures to prevent contamination with *Rhizopus nigricans*, coming about from the entrance of fruit flies to the containers. When

this difficulty was eliminated by using tight fitting moist chambers, pronounced development of sooty mold stain was induced to develop at laboratory temperatures at the end of four days. In the case of inoculated fruit placed in cold storage, a period of thirty days was required for pronounced development of the stain (pl. 31, figs. 2 and 3). In both instances, conspicuous stain development was confined to fruit receiving applications of extracted peach juice prior to inoculation. In the second set of experiments slight stain development took place on fruit inoculated but not treated with extracted peach juice, although stain development in this instance was much less pronounced than where fruit similarly inoculated was previously treated with peach juice. In each series stain development resulted to an equal extent from inoculating fruit with either the fruit or twig strains isolated by the writer. Untreated and uninoculated checks remained free of stain in all instances. Microscopical examination of stained areas showed that the discoloration consisted of black, thick-walled hyphae which when transferred again to culture media readily yielded colonies of scant mycelium giving rise to budding spores.

From the inoculations reported in the preceding, it is concluded that ripening peaches are subject to surface discolorations produced by the sooty mold fungus, *Fumago vagans*, particularly where fruit becomes smeared with the juice of ripe fruit. Stain development may take place either at laboratory temperatures, or at temperatures of refrigeration, the rate of development being much faster at the higher temperatures. At laboratory temperatures stain development was induced in the writer's experiments at the end of four days. In the case of cold storage temperatures (0° to 10°C.) a period of several weeks is required for the development of the stain. Stain growth, while superficial in occurrence, may adhere to the surface of fruit with sufficient tenacity to resist vigorous rubbing with the hands. The stain may serve therefore to blemish seriously the appearance of otherwise sound fruit.

NORTH CAROLINA STATE COLLEGE,
RALEIGH, N. C.

EXPLANATION OF PLATES

PLATE 31

Fig. 1. Peaches naturally stained with sooty mold stain photographed following shipment from Aberdeen, North Carolina, to Albany, New York.

Figs. 2 and 3. Stain development following the inoculation of fruit held under conditions of cold storage.

Fig. 4. Agar cultures of the sooty mold fungus, *Fumago vagans* Pers., isolated from naturally stained fruit following shipment from Aberdeen, N. C., to Albany, N. Y.

Fig. 5. Stain development following the inoculation of moist filter paper held at temperatures of refrigeration.

PLATE 32

Fig. 1. Mycelial filament of the sooty mold fungus, *Fumago vagans*, grown on nutrient agar.

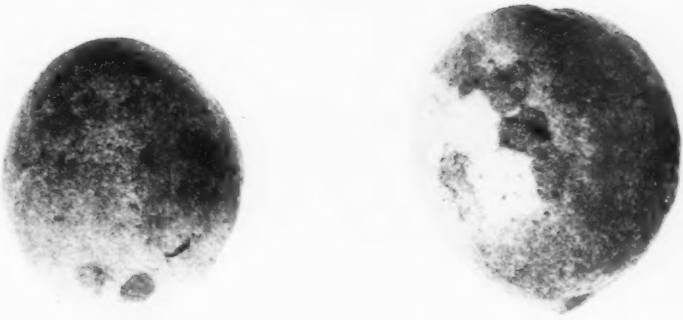
Figs. 2, 3 and 4. Production of budding conidia by mycelial filament on nutrient agar.

Figs. 5a and 5b. Olivaceous thick-walled mycelium developing in desiccated agar cultures.

Fig. 5c. Thick-walled mycelium occurring on naturally stained fruit.

Fig. 6. Young interwoven mycelial filaments eventually developing into thick-walled olivaceous strands.

PLATE 31



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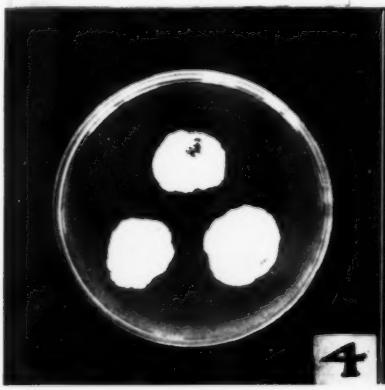

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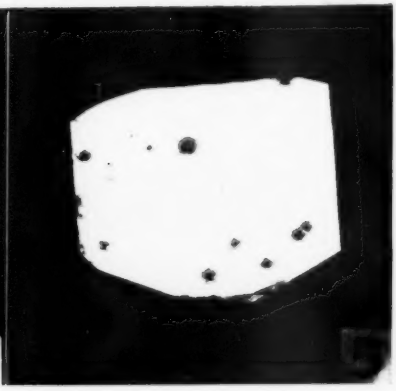

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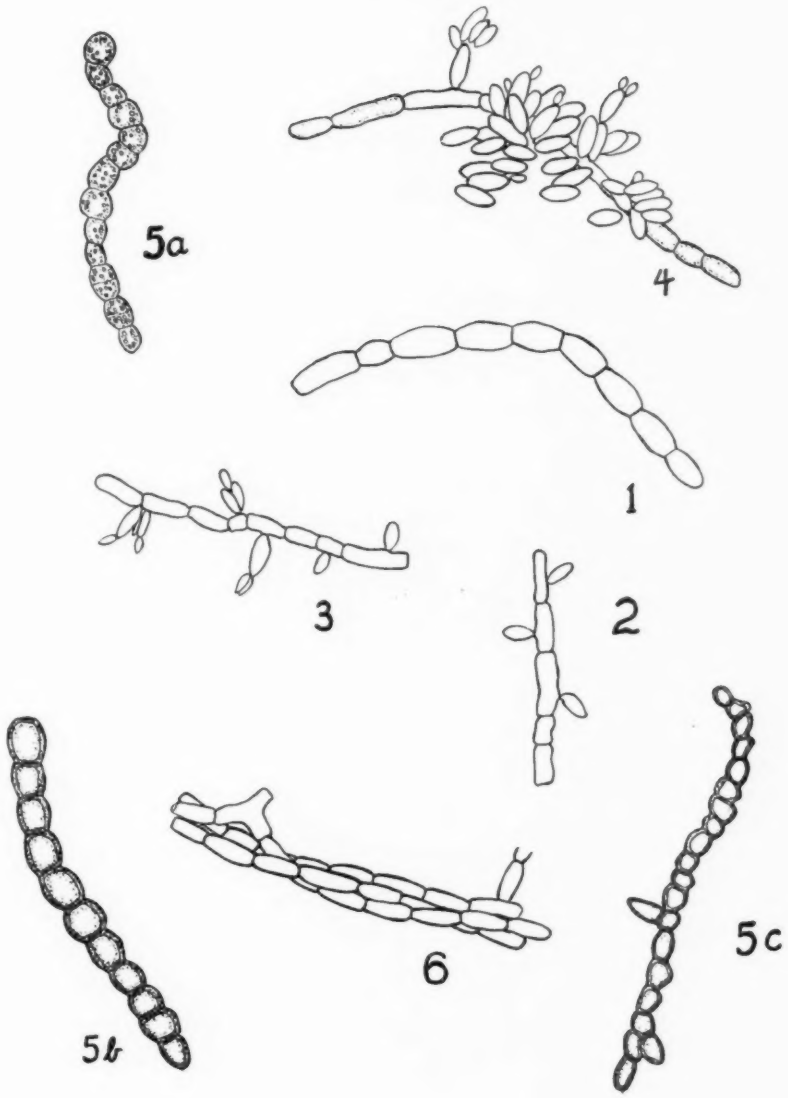
PLATE 32



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THE DISTRIBUTION OF VENUS'S FLY TRAP (DIONAEA MUSCIPULA)

By W. C. Coker

Plate 33

Ever since its discovery the distribution of the Venus's Fly Trap has remained uncertain. It was first found in the neighborhood of Wilmington, N. C., and it is still the general impression among botanists throughout the world that it is confined to that immediate vicinity. The plant seems first to have received the notice of botanists about 1763 (see below). John Bartram sent dried plants to Peter Collinson, who in 1765 sent them to Ellis who published in the form of a letter to Linnaeus a description of the plant with a plate in his book, "Directions for Bringing over Seeds and Plants from the East Indies and Other Distant Countries in a State of Vegetation," p. 35, 1770. This was published in Latin in Nova Acta Scientiarum Upsaliensis **1**: 98. 1773. Mr. Young, the "Queen's Botanist," took over to England living plants in the summer of 1768, where he grew them successfully. (See Young's Catalogue d'Arbres, etc., d'Amerique, Preface, p. VI and p. 34. 1783.) Young's record is the first we know of from South Carolina. In the above mentioned work he says (translation, p. 34):

"This peculiar plant was first known to me from the account which some of my friends gave me in 1763: some years afterward, having been sent by Her Majesty of England to America to collect new and rare plants, I found this in great abundance in North Carolina and in some parts of South Carolina, whence I brought many of them on my return to Europe; they grew in my garden near Ilswerth and flourished with their sensitive power. It was from these plants that Mr. Ellis of the society of London had the drawing of *Muscipula* made, and gave a description of it in 1780." [In error. Correct date was 1770.]

As Ellis' interesting little book is almost unavailable in this country [there is a copy in the Library of Congress], we think it would be of interest to quote his entire letter to Linnaeus in which he describes the Fly Trap. The colored plate that accompanies the letter is well done, but the inflorescence is shown too open to be at all typical. The letter follows:

London, Sept. 23, 1769.

My dear Friend,

"I know that every discovery in nature is a treat to you; but in this you will have a feast.

You have seen the Mimosa, or Sensitive Plants, close their leaves, and bend their joints, upon the least touch: and this has astonished you; but no end or design of nature has yet appeared to you from these surprising motions: they soon recover themselves again, and their leaves are expanded as before.

But the plant, of which I now inclose you an exact figure, with a specimen of its leaves and blossoms, shews, that nature may have some view towards its *nourishment*, in forming the upper joint of its leaf like a *machine* to catch food: upon the middle of this lies the bait for the unhappy insect that becomes its prey. Many minute red glands, that cover its inner surface, and which perhaps discharge sweet liquor, tempt the poor animal to taste them: and the instant these tender parts are irritated by its feet, the two lobes rise up, grasp it fast, lock the rows of spines together, and squeeze it to death. And, further, lest the strong efforts for life, in the creature thus taken, should serve to disengage it; three small erect spines are fixed near the middle of each lobe, among the glands, that effectually put an end to all its struggles. Nor do the lobes ever open again, while the dead animal continues there. But it is nevertheless certain, that the plant cannot distinguish an animal, from a vegetable or mineral, substance; for if we introduce a straw or a pin between the lobes, it will grasp it full as fast as if it was an insect.

In the year 1765, our late worthy friend, Mr. Peter Collinson, sent me a dried specimen of this curious plant, which he had received from Mr. John Bartram, of Philadelphia, botanist to the King. The flower of this specimen Doctor Solander dissected with me, and we found it to be a new genus; but not suspecting then the extraordinary sensitive power of its leaves, as they were withered and contracted, we concluded they approached near to the *Drosera* or *Rosa Solis*, to which they have been supposed by many persons since to have a great affinity; as the leaves of the most common English species of *Rosa Solis* are round, concave, beset with small hairs, and full of red viscid glands.

But we are indebted to Mr. William Young, a native of Philadelphia (to whom likewise the Royal favour has been extended, for his encouragement in his botanical researches in America), for the introduction of this curious plant alive, and in considerable quantities. He informs me, that they grow in shady wet places, and flower in July and August; that the largest leaves, which he has seen, were about three inches long, and an inch and half across the lobes; and observes, that the glands of those that were exposed to the sun were of a beautiful bright red colour, but those in the shade were pale, and inclining to green.

It is now likely to become an inhabitant of the curious gardens in this country, and merits the attention of the ingenious.

The Botanical Characters of the Genus Dionaea, according to the Linnaean Sexual System, where it comes under the Class of Decandria Monogynia.

The *Calyx*, or Flower-cup, consists of five small, equal, erect leaves, of a concave oval form, pointed at the top.

The *Corolla*, or Flower, has five concave petals, of an oblong, inverted-oval form, blunt at the top, which curls in at each side, and is streaked from the bottom upwards with seven transparent lines.

The *Stamina* or Chives, have ten equal filaments, shorter than the petals; and their tops, which contain the male dust, are roundish. This dust, or farina foecundans, when highly magnified, appears like a tricoccous fruit.

The *Pistil*, or Female Organ, has a roundish germen or embryo seed-vessel, placed above the receptacle of the flower: this is a little depressed, and ribbed like a melon. The style is of a thread-like form, something shorter than the filaments. The stigma, or top of the style, is open, and fringed round the margin.

The *Pericarpium*, or Seed-vessel, is a gibbous capsule, with one cell or apartment.

The *Seeds* are many, very small, of an oval shape, fitting on the bottom of the capsule.

I shall now give you a general description of the species of *Dionaea* before us, called *Muscipula*, or *Venus's Fly-trap*.

This plant is herbaceous, and grows in the swamps of North-Carolina, near the confines of South-Carolina, about the latitude of 35 degrees North, where the winters are short, and the summers very hot.

The roots are squamous, sending forth but few fibers, like those of some bulbs; and are perennial.

The leaves are many, inclining to bend downwards, and are placed in a circular order; they are jointed and succulent: the lower joint, which is a kind of stalk, is flat, longish, two-edged, and inclining to heart-shaped. In some varieties they are serrated on the edges near the top. The upper joint consists of two lobes; each lobe is of a semi-oval form, with their margins furnished with stiff hairs like eye-brows, which embrace or lock into each other, when they close: this they do when they are inwardly irritated.

The upper surfaces of these lobes are covered with small red glands, each of which appears, when highly magnified, like a compressed arbutus berry.

Among the glands, about the middle of each lobe, are three very small erect spines. When the lobes inclose any substance, they never open again while it continues there. If it can be shoved out, so as not to strain the lobes, they expand again; but if force is used to open them, so strong has nature formed the spring of their fibres, that one of the lobes generally snaps off, rather than yield.

The stalk is about six inches high, round, smooth, and without leaves, ending in a spike of flowers.

The flowers are milk-white, and stand on foot stalks, at the bottom of each of which is a little pointed bractea, or flower-leaf.

As to the culture of it: the soil it grows in (as appears from what comes about the roots of the plants, when they are brought over) is a black light mould, intermixed with white sand, such as is usually found on our moorish heaths.

Being a swamp plant, a north-east aspect will be the properest situation at first to plant it in, to keep it from the direct ray of the meridian sun; and in winter, till we are acquainted with what cold weather it can endure, it will be necessary to shelter it with a bell-glass such as is used for melons; which should be covered with straw or a matt in hard frosts: by this method several plants were preserved last winter in a very vigorous state. Its sensitive quality will be found in proportion to the heat of the weather, as well as the vigour of the plant.

Our summers are not warm enough to ripen the seed; or possibly we are not yet sufficiently acquainted with the culture of this plant.

In order to try further experiments, to shew the sensitive powers of this plant, some of them may be planted in pots of light moorish earth, and placed in pans of water, in an airy stove in summer; where the heat of such a situation, being like that of its native country, will make it surprizingly active.

But your knowledge of universal nature makes it very unnecessary for me to say any thing further, than that I am, with the utmost regard and esteem,

Dear Sir,
Your assured friend,
and very humble servant,
JOHN ELLIS"

In this description Ellis makes two mistakes. The minute glands on the inner surfaces of the traps do not secrete a sweet liquid for tempting the creatures, but are for the purpose of secreting a fluid that digests the victim when caught. The three bristles on each side do not of course pierce the prey but convey the stimulus when touched. Dr. Curtis was the first to give a detailed account of the plant's habits and behavior; but he did not take it for certain that the captives served as nourishment for the plants (l.c., p. 123).

Following these remarks Young gives full directions as to the successful cultivation of the plants. He says here that the seeds do not sprout the first year, but this is at least in large part incorrect, as fine plants seeding in the greenhouse at the University of North Carolina in the spring of 1927 formed abundant seedlings in the same pan a few months later.

In his Flora Caroliniana, p. 144, 1788, Thomas Walter lists *Dionaea*. His book is supposed to cover the territory more or less approximate to his home in lower South Carolina. Whether his record is from his own observations in South Carolina or not seems unknown.

In 1791 William Bartram in his Travels, p. 472, also reports seeing the *Dionaea* in abundance south of the Cape Fear River in the savannahs of Brunswick County. For a quotation from Bartram and an accurate painting, see Addisonia **10:** 1, pl. 321. 1925.

In his Genera of North American Plants (**1:** 278. 1818) Nuttall overlooks the South Carolina and Brunswick records and says, "Hitherto exclusively found on the north side of Cape Fear River, North Carolina, and no where more abundant than round Wilmington. I have traced it for 50 miles north of that place, and am informed that it extends to Fayetteville."

Mr. Canby of Wilmington, Del., noted (Gardener's Monthly, Aug., 1868, p. 229) its occurrence in parts of South Carolina adjacent to the Wilmington district. He experimented on the digestive powers of the leaf and published his results before the appearance of Darwin's well known book on insectivorous plants. As indicating the remarkable powers of the leaf, we quote his note of July 13, 1867, "I found today that a good sized leaf had caught and devoured a large centipede."

Confusion regarding the distribution of *Dionaea*, is clearly shown by a note from a correspondent in the same magazine (Sept., 1868, p. 273) who says:

"I have had plants from the boggy grounds on the table lands in Georgia, and plants have been sent from there to Kew, and my impression is they can be found pretty plentifully there now."

We hardly think it is going too far to say that this is certainly a mistake. Such reports are being constantly made by people who take the pitcher plants for *Dionaea*.

Elliott on the authority of Gen. C. C. Pinckney of Revolutionary fame records the plant as growing "plentifully on the margins of the creeks running into the Santee River from the south, between Lynch's Ferry and the sea; particularly at Collin's and Bowman's bridges." (Sketch, etc. **1:** 479. 1821.)

Mr. H. B. Croom of New Bern, a graduate of the University of North Carolina, and author of a Catalogue of Plants in the Vicinity of New Bern, N. C., writing in 1834, says (Amer. Journ. Sci. **26:** 313. 1834): "It is probable that it will be found to extend from the Albemarle Sound to the Pee Dee River,[1] at which last place it was observed by Gen. C. C. Pinckney." Later Mr. Croom, in the Catalogue of New Bern plants above mentioned, says that he has "ascertained that this plant, which, for a long time, was supposed to be confined to the neighborhood

[1] He corrects this to Santee River in the same Journal **28:** 168. 1835.

of Wilmington, N. C., occurs in the counties of Bladen, Duplin, Jones, Lenoir, Onslow and Craven."

The Rev. M. A. Curtis, a botanist of excellent reputation, says of *Dionaea* (Catalogue of Plants Growing Spontaneously around Wilmington. 1834):

"This plant is found as far north as New Bern, N. C., and from the mouth of the Cape Fear River nearly to Fayetteville. Elliott says on the authority of Gen. Pinckney that it grows along the lower branches of the Santee in South Carolina. Dr. Bachman has received it from Georgetown, S. C., and Mr. Audubon informed me, with the plant before us, that he has seen it in Florida, of enormous size. I think it not improbable, therefore, that it inhabits the savannahs, more or less abundantly, from the latter place to New Bern."

In commenting on this statement of Dr. Curtis', Dr. T. F. Wood says (Mitchell Journal **3**: 77. 1886): "I find upon diligent inquiry that it is not to be found at Georgetown but near Bucksville, S. C., about 70 miles from Wilmington and is very scarce there."

In 1892 Bashford Dean says (Trans. N. Y. Acad. Sci. **12**: 9–17. 1892):

"The plant's northern range appears to be sharply drawn at the Cape Fear River. West of Wilmington the plant occurs, but it is said to be rare. Southward it is still more uncommon; it has been taken by Walter Hoxie of Beaufort, S. C., on Fripp's Island, on Coxspur Island, off the Georgia coast, and once at the head of Mosquito Lagoon below St. Augustine."

On reading this statement of Dr. Dean's about 18 years ago I at once undertook to get in communication with Mr. Hoxie, and at last found that he had moved to Savannah. After some correspondence I went to Savannah to see him and soon found that if he had ever seen *Dionaea*, which was very doubtful, he could not now find it.

In regard to the Georgetown record, we may add that there is in the Herbarium of the New York Botanical Garden a collection labelled from Georgetown (with no date) made by the Rev. Alexander Glennie. However, from all the evidence we agree with what Dr. Wood says above in regard to these Georgetown records. Mr. James Henry Rice, Jr., of Wiggins, S. C., who is notably well posted on the coastal region of South Carolina and who is thoroughly familiar with *Dionaea*, in a letter to me (July 18, 1927) says:

"From the vicinity of Georgetown means somewhere within fifty miles," and adds that a number of Georgetown planters, such as the

Withers, Allstons, and others, had plantations near Withers's Swash, the present Myrtle Beach. Mr. Rice thinks that plants collected at Myrtle Beach would be distributed in the old days under a Georgetown label. He further says:

"During a residence of ten years in and around Georgetown, hunting over the country, looking timber, etc., I never once met with *Dionaea*, nor did I ever hear of it. One may be fairly certain that the plant was never found west of Waccamaw river, in *Georgetown county*.

"Since 1898 I have found it repeatedly from the northern rim of the hammocks north to the mouth of Cape Fear river; it begins to be abundant near Ocean Drive. I have seen whole patches of the plants in the pinelands in North Carolina, between Calabash and Supply. They grew in masses." I, too, have looked for the plant a number of times around Georgetown and have written some of the best posted older people of that section about its occurrence, but have never found it and have no evidence that it grows near there.

For a number of years I have been trying to get together actual collections of *Dionaea* to illustrate its true range, and can now confirm its occurrence in South Carolina as far south as Murrell's Inlet. I can report also a remarkable western extension of its range to Lakeview 30 miles west of Fayetteville, which has heretofore been considered its western limit.

I am printing herewith an outline map (pl. 33) indicating the true range of the plant so far as at present known. On this map circles are used to designate actual stations represented by collections in herbaria, all in the University of North Carolina, United States National Herbarium or New York Botanical Garden. Cross marks indicate stations not represented by collections but confirmed to a practical certainty on good authority. The Neuse River collections at Washington were made by Gerald McCarthy and are noted as from "wet savannahs, Neuse River, July 7, 1884." We put the circle at Newbern on the Neuse as it was said by Croom to occur there. The Pinckney-Elliott record below the Santee River has remained unconfirmed to date, though Pinckney was a man of excellent ability and some reputation as an amateur botanist, and this station cannot be dismissed without a most careful search. Audubon's statement to Curtis that he had seen it in Florida of enormous size must almost certainly be dismissed as an error.

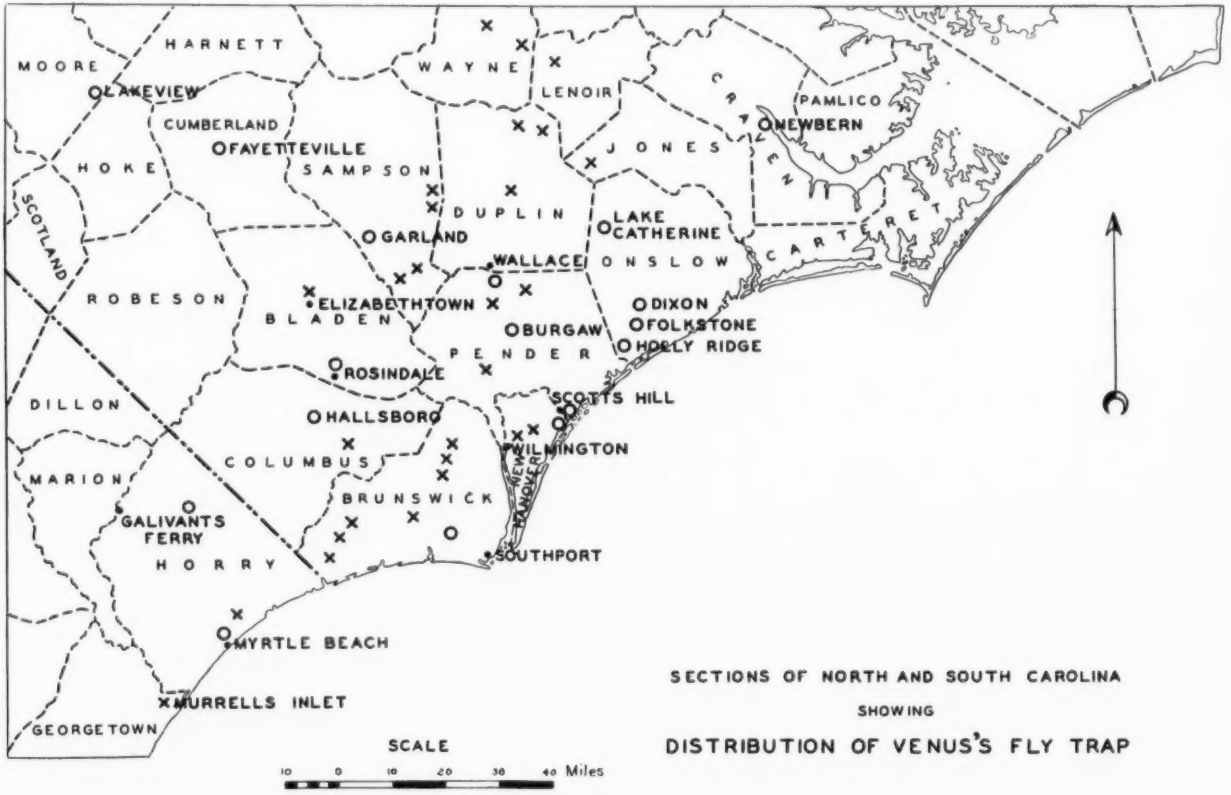
We can say then that the plant occurs in eastern North and South Carolina, inhabiting often in scattered and distant colonies an area of 155 miles north and south, from New Bern to Murrell's Inlet, and about 115 miles east and west from the seacoast to Lakeview.

In regard to the actual numbers of plants at any one so-called station and any danger of its extermination, it may be said that the plants are still growing in two states in vast numbers, and that the danger of extermination is very remote. Wood and McCarthy in their Wilmington Flora (Mitchell Journal **3:** 88) also express the opinion that the plant is in no danger of early extermination. Its continuance in certain stations now known is, however, in many cases precarious. For instance, at the westernmost station near Lakeview, details of which have kindly been furnished us by Mr. R. E. Wicker, there are four separated colonies occurring in an area of about one-half mile in length. The four together are estimated by Mr. Wicker to contain about 1000 plants. This entire station could easily be wiped out by any commercial development of the area. In New Hanover and Brunswick Counties, however, the plants are so widely distributed and so abundant that they remain by the millions, although many of their stations have been destroyed by new land developments around Wilmington.

As this is not an article on the structure and habits of *Dionaea*, we omit references to nearly all the literature on the subject. Most of it can be found in papers by J. M. Macfarlane and John W. Harshberger in Contributions from the Botanical Laboratory of the University of Pennsylvania **1:** 7, 45. 1892.

In Harshberger's paper is shown a remarkable abnormality (pls. 5 and 6) with young plants being produced adventitiously by bud propagation in the inflorescence.

In conclusion we wish to acknowledge with thanks the coöperation of the following in establishing important records: R. E. Wicker, Pinehurst, N. C.; W. Bedford Moore, Jr., Columbia, S. C.; D. R. Coker, Hartsville, S. C.; James Henry Rice, Wiggins, S. C.; L. E. Singleton, Myrtle Beach, S. C.; A. J. Baker, Conway, S. C.; and Solomon Gore, a negro boy who found the Pine Island station and led us to it.



SECTIONS OF NORTH AND SOUTH CAROLINA

SHOWING

DISTRIBUTION OF VENUS'S FLY TRAP

PLATE 33

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NOWAKOWSKIELLA AND A NEW SPECIES OF PYTHIUM

By Velma Dare Matthews

Plates 34 and 35

Nowakowskiella elegans (Now.) Schroet.

Plate 34

While examining a sterile culture of *Achlya*, which had been isolated from the soil a very small fungus was observed growing along with it. The small fungus seems to be *Nowakowskiella elegans* (Nowakowski) Schroeter, which was described by Nowakowski from the slime of *Chaetophora elegans* in Breslau, Germany, and there does not seem to be any record of its occurrence in the United States. It differs from *N. elegans* only in that proliferating sporangia were not found. Butler's *N. ramosa*, which was described from rotting wheat stems in India differs from this plant only in the presence of resting spores.

The fungus will grow as a saprophyte on the hulls of boiled hemp seeds in water but it grows best on boiled yard grass stems and leaves in distilled water. Growth is quite slow in comparison to that of *Pythium* and members of the Saprolegniaceae, as it is usually about a week before sporangia are formed after they are transferred to fresh media. The sporangia are formed in the water outside the substratum or inside the cells of the substratum. When grown on grass the mycelium develops extensively in the tissues of the grass and is characterized by the presence of many swellings as shown in figure 2. The sporangia arise either from terminal or intercalary swellings. The swelling which is to become a sporangium soon becomes divided off by the formation of a wall or walls (fig. 4). The protoplasm of the sporangium initial is usually more granular than that of the subtending parts. The attached hypha swells at the point of contact and becomes the apophysis which is usually well developed, even more so than shown in the figure of *N. elegans* and *N. ramosa*. In cases where the sporangia are intercalary there is an apophysis on each side (fig. 7). The sporangium then enlarges and the protoplasm becomes vacuolated (fig. 5). Growth continues and the protoplasm becomes more dense (fig. 6),

soon after which numerous small oil drops appear in the protoplasm. The zoospores are then cut out around the oil drops (fig. 7). Before the spores are liberated a papilla is formed at any place on the sporangium. The length of the tube of discharge seems to depend largely on the position of the sporangium. When sporangia are formed out in the water it is usually rather short or absent (fig. 10) but when sporangia are formed inside the cells it may be very long and branched or there may be several (figs. 3, 11).

When the spores are ready to be discharged the tube opens by throwing off a cap or operculum (fig. 12). A large number of the zoospores then pass out rapidly and remain at the mouth of the sporangium for a short time. They then separate and swim away singly as spherical spores with a long cilium directed backwards. Usually a large number of spores are left in the sporangium; often it seems to be quite full after the first have emerged since a very large number are formed in each sporangium. These spores emerge singly in an amoeboid fashion and move around in an amoeboid manner outside the sporangium for a few minutes after which they round up and swim away as spherical spores exactly like those which escaped from the sporangium first. The zoospores soon come to rest and germinate, often forming two germ tubes which soon branch.

A technical description follows:

Mycelium intra- and extra-matrical, extending out into the water for some distance from the substratum, often arising in tufts of a number of hyphae (fig. 1), then spreading in all directions. Hyphae usually with a number of irregular swellings, varying greatly in size from less than 1μ to about 9.6μ thick in the swollen places. Sporangia terminal or intercalary, spherical to elongated, 20–40μ in diameter (when borne inside cells of boiled grass often same thickness as grass cell), usually with a very prominent apophysis, opening with an operculum. Zoospore usually about 7.2μ in diameter (may be larger) when spherical, with a distinct oil drop and a long cilium, formed before opening of operculum, first ones escaping in a mass then soon separating and swimming away; remaining spores escaping singly and passing through various amoeboid movements before swimming away. Resting spores not formed.

Obtained from fresh water beach sand at Elizabeth City, North Carolina, collected by W. C. Coker and H. H. Braxton on September 15, 1927, growing with a sterile species of *Achlya*.

Pythium papillatum n. sp.

Plate 35

A *Pythium* was isolated from the soil by Mr. A. C. Matthews, a student in Botany 4, and was assigned to me for study. It appears to be a new species most nearly related to *P. aphanidermatum*.

It differs from the latter in that antheridia are absent, many oogonia are intercalary, and the eggs usually fill the oogonium except for the necks and papillae, which are often present. It differs from *P. monospermum* in the absence of antheridia, larger hyphae and larger eggs with thin walls; and from *P. torulosum* in the absence of antheridia, larger oogonia and eggs, larger spores and much less swollen and complicated sporangial complexes.

The fungus grows well as a saprophyte on boiled hemp seed in water but oogonia are formed in only a few cultures and only when the cultures are quite old. When formed, however, they are often very abundant.

Zoospores are plentifully produced in a manner typical of the Aphragmium group, the number of zoospores produced in a vesicle varying according to the amount of protoplasm present.

The name refers to the papillae that are often present on the oogonia. Papillae or spines occur in some other species of *Pythium* but not in the section Aphragmium.

A technical description follows:

Mycelium dense, extending for a centimeter or more from the substratum, when grown in water on boiled hemp seed. Hyphae very irregular in size; main hyphae up to 24μ in diameter at base, ordinary hyphae about 7.2μ thick, forming numerous bud-like outgrowths in old cultures as in *P. monospermum* and *P. aphanidermatum*, not nearly so dense or complex as in *P. torulosum*. Sporangia filamentous, short or often very long, arising from unbranched hyphae or highly branched ones, usually very slender near the vesicle, often only about 3.6μ thick. Zoospores from a few to 20 or more to a sporangium, usually about 12 x 7.2μ, soon encysting with a diameter of about 12μ. Oogonia 16.8–26.4μ in diameter, terminal on short branches, very often intercalary, often with several in a chain (rarely up to 5), spherical to oval, often with a long neck, smooth or with one or two prominent papillae. Eggs 16–24μ in diameter, usually entirely filling the oogonia except for the necks and papillae, usually spherical with a distinct central oil drop and a thin wall. Antheridia lacking.

Obtained from soil in Chapel Hill, North Carolina, December 1927, A. C. Matthews, coll.

This work was done under the direction of Dr. W. C. Coker, to whom the writer wishes to express her appreciation.

UNIVERSITY OF NORTH CAROLINA,
CHAPEL HILL, N. C.

EXPLANATION OF PLATES

PLATE 34

Nowakowskiella elegans

Fig. 1. Habit sketch showing tuft of hyphae on edge of grass leaf. × 143.
Fig. 2. Mycelium growing on grass showing swollen places in hyphae. × 143.
Fig. 3. Empty sporangium formed inside grass tissue showing branched tubes of discharge. × 291.
Fig. 4. Young sporangium with apophysis. × 655.
Figs. 5, 6. Young sporangia. × 655.
Fig. 7. Sporangium showing oil drops and beginning of spore formation. × 655.
Fig. 8. Sporangium discharging first spores in a mass. × 655.
Fig. 9. Spores left in sporangium escaping singly in amoeboid manner. × 655.
Fig. 10. Empty sporangium showing operculum. × 431.
Fig. 11. Empty sporangium in grass cell. × 291.
Fig. 12. Empty sporangium showing tube of discharge and operculum. × 431.
Fig. 13. Sporangium in cell of grass. × 291.
Fig. 14. Sprouting spore. × 655.

PLATE 35

Pythium papillatum

Fig. 1. Sporangium, showing protoplasm just after passage into vesicle. × 291.
Fig. 2. Vesicle with spores. × 655.
Fig. 3. Hyphae showing numerous branches. × 143.
Fig. 4. Vesicle with very few spores. × 291.
Fig. 5. Free swimming spores and encysted spore. × 655.
Fig. 6. Oogonium showing two eggs and a cross wall. × 655.
Fig. 7. Oogonia in a chain. × 655.
Fig. 8. Young oogonium. × 655.
Fig. 9. Smooth oogonium. × 655.
Figs. 10, 11. Intercalary oogonia. × 655.
Figs. 12–14. Oogonia with spines. × 655.

PLATE 34

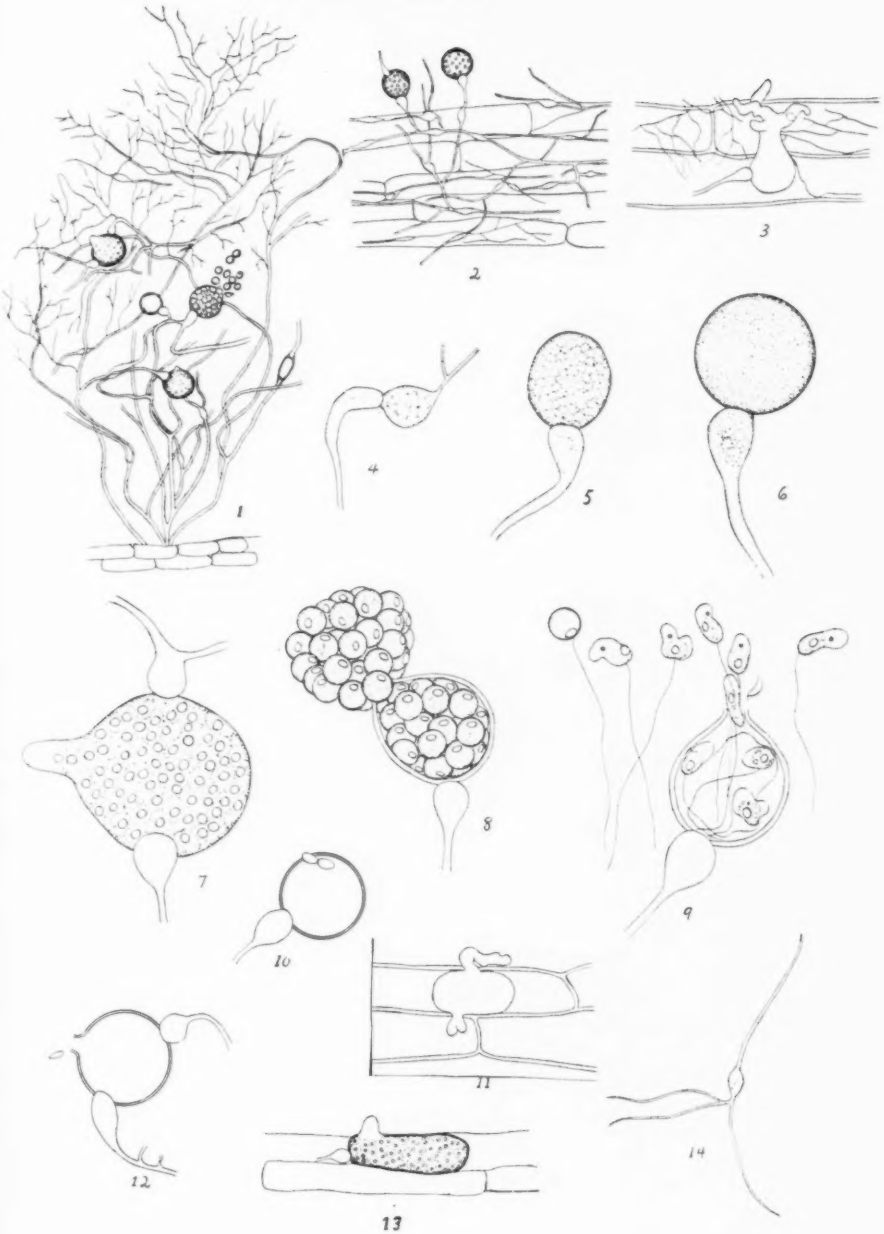

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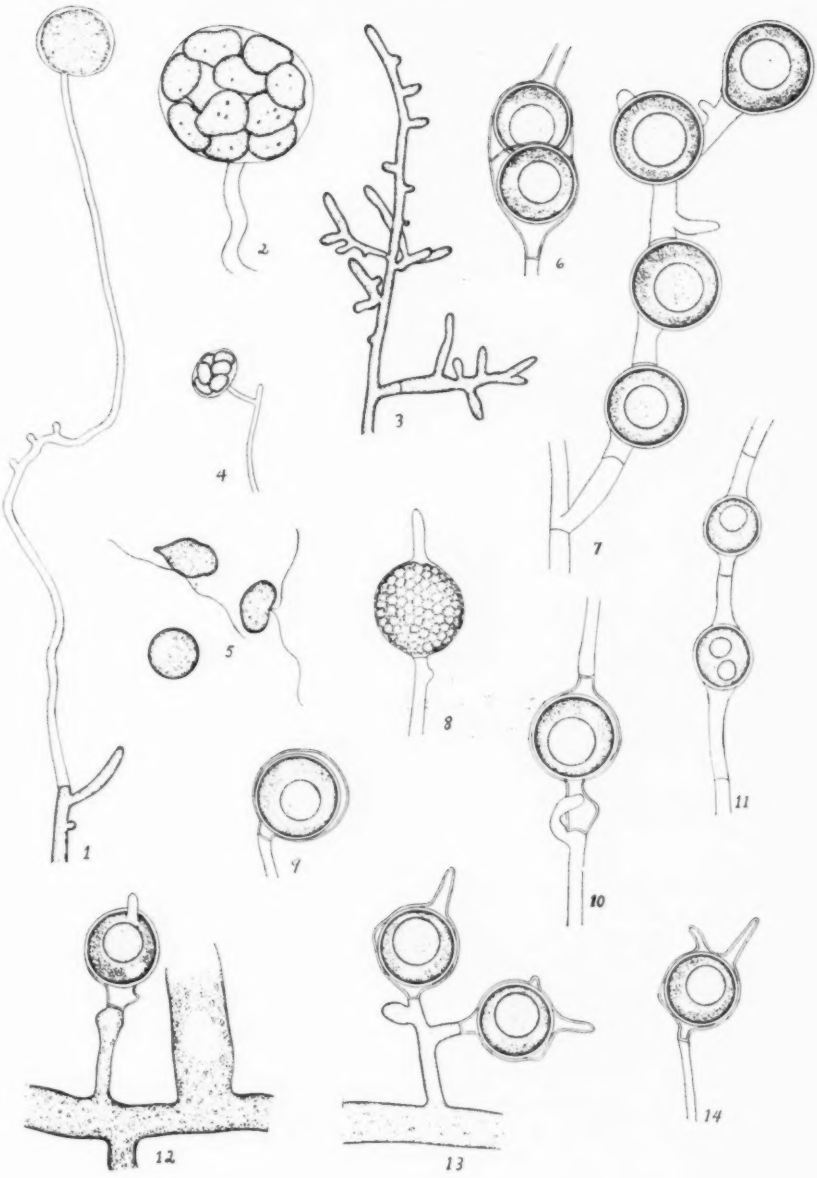
PLATE 35



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NOTES ON BASIDIOMYCETES

By W. C. Coker

Frontispiece and Plates 36, 37, 47, 48

Saccoblastia caroliniana n. sp.

Saccoblastia ovispora Möller var. *caroliniana* Coker

This was described by me as a variety of Möller's species (this Journal **35**: 121. 1920). At the time I had not seen any other species of *Saccoblastia* and wished to be conservative. I later sent some to Bresadola who has described a species of *Saccoblastia* and seems to have seen *S. ovispora*. He writes as follows: "For me it is a species quite distinct from *Saccoblastia ovispora*. The genus *Saccoblastia* is not gelatinous; your species is gelatinous like *Platygloea*; it connects the genus *Platygloea* with *Saccoblastia*, of which it has the structure."

It would seem from the above that Bresadola would consider my plant a new genus, but I am not inclined to think that anything would be gained by taking it out of *Saccoblastia*.

Sirobasidium sanguineum Lager. & Pat.

Frontispiece and Plate 47

Emerging from the unbroken bark as small, pale amber, convoluted, gelatinous pustules which as they grow become more convoluted to appear like a lot of folded intestines, the color deepening to dark reddish brick, about terra cotta to yellow-red or to cranberry, the convolutions small and rather regular; surface very minutely granular, slippery but hardly viscid. Cushions varying from about 3 mm. to 2 cm. broad and 1–5 mm. thick.

Hyphae about 2.5–3.8μ thick, frequently branched, the septa with clamp connections; dilute orange in color.

Spores varying in shape, mostly subelliptic, pointed and bent at one end, 5.5–7.7 x 15–23μ, rarely as short as 12.2μ. Basidia deeper colored than the hyphae, reddish brown, mostly pear-shaped, 12–15μ thick and up to 24μ long, irregularly divided into 4 cells. After standing a few

hours the spores begin to sprout in a yeast-like way to form one or more subspherical sporidia, 8.2μ or less in diameter, which in turn may sprout in the same way in one or more places to form still smaller ones, and this may be repeated several times so that the final products may be as small as 1.5μ.

Lagerheim and Patouillard's description (Journ. de Bot., Paris, **6**: 469, text fig. 2. 1892. See also Revue Myc. **15**: 35, pl. 133, figs. 1, 2. 1893) agrees so well that I have no doubt as to the determination. This figure shows basidia in chains and spores, the latter sessile as in ours. They show no basidia so spherical as some of ours, but that is not important. The spores are identical. They did not observe the spores sprouting and only show the basidiospores.

This adds a species to the North American continent. It was described from Ecuador on dead wood and has apparently never been reported since. After determining it as *sanguineum* I sent a piece to Bresadola, who wrote: "Species very interesting. I believe it is indeed the species of Patouillard and Lagerheim. The spore is not exactly fusoid, but nearly so."

4728. On a corticated dead privet shoot, Dec. 14, 1920.

Exidia minutissima n. sp.

Plate 47

Minute, pulvinate, smooth or with a few convolutions, from less than 1 mm. to about 2 x 3 mm. broad, separate or touching in small groups, almost hyaline with a faint tint of pink or smoke. Practically invisible without a lens; drying to a brownish membrane.

Basidia subspherical, 8–9μ thick, divided longitudinally into four cells with long sterigmata. Spores smooth, oblong-elliptic, 3.7–4.5 x 7.4–10.5μ.

The texture is about that of *E. glandulosa*. There are no papillae. Distinguished by minute size and pale color.

4431. On corticated oak branch on ground mixed with *Guepinia spathularia*, July 16, 1920.

Exidia candida Lloyd

Plate 47

Lloyd (Myc. Notes, p. 620) gives the spores as 8 x 16μ, slightly curved. He later (Myc Notes, p. 1045) refers to this species a plant

from Idaho (Weir) and gives the spores as curved, 8 x 14μ; basidia 6 x 20μ. We have a good collection of this plant from Weir himself, same locality and probably a part of the lot sent Lloyd. Burt gives the spores of a plant from Bingen, Washington (Suksdorf, No. 751) as 4–4.5 x 12–13μ (Ann. Mo. Bot. Gard. **8**: 367). We find the spores of the Idaho plant to agree with Burt's measurements, elongated, curved, 4–5 x 9.5–13μ; basidia about 15μ thick. There are no gleocystidia.

This plant is known so far only from Washington (type) and Idaho.

Exidia alba (Lloyd) Burt
Exidiopsis alba Lloyd
Seismosarca alba Lloyd

This is an American plant and apparently a true *Exidia*. We have not seen it, but it seems to be easily distinguished by its large size, pale color and especially by the conspicuous, dark gleocystidia (see Lloyd's figures, Myc. Notes, figs. 1928, 1929). It should be looked for in this state, as it has been found in New York and Alabama and is said to be abundant in the Mississippi valley. Burt gives the spores as 4.5 x 9–10μ (Ann. Mo. Bot. Gard. **8**: 366. 1921); Lloyd as 6 x 12μ (Myc. Notes, p. 1045).

Tremella albida (Huds.) Fr.

This species is still badly confused. Brefeld seems to have been the first to study a plant that he took to be this species. He found it to be an *Exidia* with long, curved spores. He gave them as 7 x 20μ. Karsten later gives them as 4–6 x 12–14μ (Saccardo **6**: 775. 1888). Lindau gives them as 5–7 x 15–20μ (Mark Brandenburg **5a**: 917). All these are considering a true *Exidia*. Lloyd follows this idea but he does not seem to have studied the English plant, although given one by Cotton (see Letter 44, p. 9). He says that the English plant does not "look like" the American one that he calls *Exidiopsis alba*. On the other hand Rea (Brit. Basidiomycetae, p. 731) treats the Hudson plant as a *Tremella* (*T. albida*), and the plant he describes is a true *Tremella* (spores globose, 9–10μ). Bresadola follows Brefeld, as is shown by plants in his herbarium. We have a plant from him (Lendschow; Grisebach, coll.) of which he gives the spores as 4.5–5 x 14–18μ. From labels in his herbarium, Bresadola considers *E. Thuretiana* (Lév.) Fr. the same as *E. albida*.

Eichleriella pulvinata n. sp.

Plates 36 and 47

Plant gregarious, single or less often confluent in small groups, pulvinate in center with a thin effused margin, about 1–4.5 mm. long, 1–3 mm. broad and 0.5–1.5 mm. thick, attached centrally below and expanding loosely over the bark around the attachment, margin blunt, exposed surface covered with the hymenium, glabrous, even or a little irregular, when fresh dull watery brown or buffy to ochraceous brown, the margin paler and buff to whitish and when dry often somewhat elevated from the bark. Texture very firmly waxy, not gelatinous, subtranslucent, context composed of dense, irregular, branched threads about 3–4μ thick, colorless in section.

Spores hyaline, smooth, bent-elliptic, 5.5–7.5 x 15–21μ. After standing on a slide in a damp chamber some of them divide into 2–6 cells. Under the same conditions some sprout whether divided or not into one or several hyphal threads, while others form secondary pip-shaped spores on short sterigmata. Basidia oval or pyriform, 4-celled, 11–16.7 x 22–32μ, embedded about 12–16.5μ below the surface. Paraphyses like the context threads, more or less branched above and colored brown toward the surface.

The hymenium is in most places stratified, showing as many as three periods of growth and spore production. The older, first-formed series of basidia, may be easily made out in thin section about as far below the next series as the youngest layer is below the surface.

This remarkable plant differs from all other species of this genus in being composed of colonies of thick, pulvinate individuals, reminding one of the larger scale insects, in the occurrence at times of septate spores, and also apparently in the stratified hymenium. This seems nearest *E. spinulosa* (B. & C.) Burt (*E. Kmetii* Bres.), but the plants are entirely different in appearance and the tubercles of the latter are little scattered spines set on an extensively effused surface. We have good examples of *E. Kmetii* from Bresadola. Our plants when dry are ashy gray to reddish brown or blackish brown, the margin always whitish except in very old specimens. If kept in a damp chamber for a day or two the formation of a new hymenium is begun and as a result the surface becomes minutely tomentose, the margin most conspicuously so.

5162. On fallen twigs of hickory, June 4, 1922.

5258. On fallen twigs of same hickory as No. 5162, June 18, 1922. The spores of this lot were just like those above, except that none ever divided.

Arrhytidia involutus (Schw.) n. comb.
Dacrymyces involutus Schw.
Arrhytidia flava Berk.
Dac. corticoides E. & E.
Ceracea corticoides (E. & E.) Pat.
Ceracea aureo-fulva Bres.

Lloyd has examined the type of *Arrhytidia flava* and finds it to be a *Ceracea*. As Berkeley's genus antedates *Ceracea* it should be used. The original came from South Carolina and grew on pine wood. We have no doubt that it is the same as the Schweinitz species which grows on pine and is not rare in this section (treated by us as *Dacrymyces involutus* in Journ. E. M. Sci. Soc. **35**: 164. 1920). Lloyd thinks the species is the same as *Ceracea Lagerheimii* (Myc. Notes, p. 899). We have an authentic bit of this from Patouillard (Ecuador), and find that it agrees exactly in appearance with *A. involutus*. The spores, too, agree better than the description would indicate. They are in the Ecuador plant 5–6.5 x 11–14μ. However, as we could find only one cross wall in any of them, and as the plant is not said to grow on conifers (the only substratum mentioned specifically is a woody grass, *Chusquea*), we do not feel sure of the identity of the two. Aside from *Ceracea vernicosa*, of which nothing is known except the inadequate first description, the only other described species is *C. aureo-fulva* Bresadola which grows on coniferous wood in Europe. We have an authentic piece of this from Bresadola (Konigstein, Krieger, coll.) and find it the same as our plant, as one would suppose from the description.

Arrhytidia enata (B. & C.) n. comb.
Tremella enata B. & C.
Dacrymyces enata (B. & C.) Massee

Abundantly and closely gregarious, emerging on the bark without breaking through it, but lifting and rupturing only the tissue-like epidermis; appearing at first as little brownish amber tubercles which immediately begin to grow out a thin resupinate layer on the bark around them; these layers soon meet to form a continuous film unless the tubercles are several mm. apart. Each tubercle is usually nodulated above like a molar tooth with two to four cusps, the interior paler and less translucent and each cusp is apt to have one of these paler spots beneath it. Texture of all parts very firmly waxy, distinctly harder than in any *Dacrymyces*. Diameter on emerging about 1–2 mm., but at

times the tubercles themselves are so crowded as to fuse in lines up to 5 or rarely more mm. long. (This does not refer to the thin resupinate layer which may connect extensive groups.) Hymenium yellowish, very dense and firm, separating rather easily from the context, 60–130μ thick, increasing in thickness with the age of the specimen. Basidia closely packed, 2-forked, 20–27μ long, including the forks which are about 7–11μ long; thickness just below the prongs about 3.7μ. Through the hymenium are scattered very slender, sparingly branched hyphae which project as far or further than the prong tips. These threads are much scattered and have no characteristic way of branching.

Spores (of No. 4989) 3.4–4.2 x 8–11μ, sausage-shaped, pure white in a good print, slowly divided into 4 cells, or undivided.

Older plants become deep sordid brown and when dry young plants are dark amber-brown, old ones nearly or quite black. In all stages they are seen with difficulty on the dark bark. Upon drying the plants do not shrink much and the thin edges often curl up a little as in *Eichleriella*. The hymenium extends over the resupinate layer as well as the cushions. There is no obvious root as in *A. involutus*.

In our *Tremella* paper (this Journal **35:** 149. 1920) we mentioned this species as not yet understood by us. Since then we have restudied the Curtis Herbarium specimen No. 2456 on oak and a Kew part of the same collection, kindly given us by Miss Wakefield. We find this collection to be the same as our plant here treated. As previously stated, the type on alder given as No. 2191 (Grevillea **2:** 20. 1873) is not represented in the Curtis Herbarium. Massee has studied a Kew specimen on alder that he calls the type but gives as No. 4307. He finds it of the *Dacrymyces* type but his basidial measurements do not agree with ours, and neither does his habit sketch. The spores, however, agree well (Journ. Myc. **6:** 182, pl. 7, figs. 14, 15. 1890). The Berkeley and Curtis No. 2456 on oak does not agree well with the description. It is conspicuously not erumpent and has no flocci. However, it is exactly the same as our plants and we are taking it to be the species. There is another collection of *A. enata* in the Curtis Herbarium (determined by Curtis) on alder from Massachusetts, Sprague, No. 1032. In appearance it is identical with ours and the hymenium is the same, dense, yellowish, 130μ thick. The only other collection we have met with in herbaria is in the New York Botanical Garden, labelled *Naematelia* sp., on *Myrica cerifera*, Newfield, N. J., 1885 (Ellis, coll.). It has all the characters of our plant and is undoubtedly the same. In the New York Botanical Garden is a collection from Fayette County, W.

Va., on oak, that was determined as *D. enata* by Massee. It is, however, quite different from that species.

The very firm waxy texture and the thin resupinate film that surrounds and connects the tubercles indicate *Arrhytidia* rather than *Dacrymyces*, and we are transferring the species to that genus.

If the type is ever certainly found and shown to be different, our species will have to be given another name, but it is very distinct and at present may as well be considered *enata*.

North Carolina. Chapel Hill No. 4989. On dead alder branches, Feb. 7, 1922.
South Carolina. Society Hill. No. 2456 (Curtis Herb., co-type).
New Jersey. Newfield. Ellis. (N. Y. B. G. Herb., as *Naematelia* sp.).
Massachusetts. Sprague, No. 1032. (Curtis Herb.).
Reported by Peck from Forestburg, N. Y. (Not seen by us) (Rept. N. Y. St. Mus. Bull **27:** 100).

Dacryomitra glossoides (Pers.) Bref.
Clavaria glossoides Pers.
Calocera glossoides (Pers.) Fr.

Frontispiece and Plates 37 and 48

Plants gregarious, single or crowded in rows, 0.5–2 cm. high, with a distinct sterile stalk up to 1.3 cm. long and 3.5 mm. thick, which is terete or irregular and tapers to a point below; the hymenium covering the expanded, gyrose, irregular, sub-capitate head; color of stem a pale watery pinkish cream, of the cap a pale, watery orange; base of stem pale greenish (in most of the plants of both this and No. 4419), with more or less of a flesh tint. Texture firmly gelatinous and translucent in both cap and stem, slippery; threads of the flesh 3.5μ thick, moderately branched, no clamp connections, the joints a little swollen (up to 5μ).

Basidia not large, 4.5μ thick below fork, the prongs up to 22.5μ long and 3.5μ thick before collapse. Spores (of No. 4417) a clear orange, more colored than the hymenium, smooth, elongated, with a smaller, much-bent end, 4-celled, 4.5 x 11–14μ, sprouting soon into small oval sporidia on short stalks.

The dull olive color at the base of most of the plants is due to the attacks of a parasitic fungus with smoky color and short thick cells

which run among the smaller threads of the host. This infected base darkens still more in drying and shows up in stronger contrast to the deep reddish orange of the remainder of the dried plant. In texture the cap is not different from the stem. The plant always grows on decorticated, distinctly rotten logs of deciduous trees.

In our earlier paper we described and figured a plant as *D. dubia*, giving *D. glossoides* as a synonym with a question. The present plant seems to be different from our *D. dubia*, as shown by smaller spores, pointed base, much more convoluted head and growth on deciduous wood. We are now satisfied that the former is *D. glossoides*. The microscopical characters as given by Bresadola for *D. glossoides* (Ann. Myc. 1: 115. 1903) agree throughout. Spore measurements given by Hennings (Nat'l. Pflanz. I. 1: 100. 1900) are longer. See illustration by Hennings, l.c., fig. 63 s-u. *Dacromitra pusilla* Tul. may be the same thing, but the spores as given are too narrow and the head too narrow and elongated.

4417. Decaying deciduous log in flat below Meeting of the Waters, July 16, 1920.
4419. Decaying deciduous log in flat by branch, northwest corner of Rocky Ridge Farm, July 16, 1920.
4443. Decaying oak log over Battle's Branch, July 17, 1920.
4645. Oak log on bank above Meeting of the Waters, August 7, 1920.
5292. On rotten oak wood, July 6, 1920. Plants watery orange, no green at base. Spores orange, curved-elliptic, 4-celled, 4.2–5 x 10–11.5μ.
5396. On decorticated sweet gum, July 24, 1922. Plant smaller and redder and with shorter stalk than usual. Spores 4.4–6 x 10–14.8μ, 4-celled, sprouting into minute threads, or not rarely into sporidia.
7047. On a deciduous log in swamp, August 5, 1923.

Blowing Rock. Coker. (U. N. C. Herb., Nos. 5783, 5809).

Cyphella minutissima Burt

Plate 48

Plants minute, gregarious, sessile, cup-shaped to muff-shaped, 200–400 x 200–500μ, the opening much constricted; villose externally with encrusted hairs; snow white, waxy, easily crushed.

Basidia 4.4–6.2μ thick with 4 sterigmata. Spores subspherical with a distinct mucro and a single large oil drop, white in a print, smooth, 4–5.5 x 4.8–6.6μ.

This very rare and beautiful little species has been found heretofore only in New Hampshire and Vermont.

4917. On a decorticated fallen pine branch, December 3, 1921.

Cyphella subgelatinosa Berk. & Ravenel

Plate 48

Plants minute, gregarious in large colonies and cespitose in groups of 2–10 or more, individuals 0.3–0.7 mm. broad and about the same height, cup-shaped with the mouth constricted (subspherical); mouse gray with a surface covering of white, heavily encrusted, minute hairs which give the appearance of a crusty powder; sessile, pendent and attached laterally by one side at the top. Texture tender and elastic, about that of gum drops; easily crushed.

Hymenium lining the inside of the cup sordid yellow under the lens, only about 70μ thick. Basidia clavate, 4-spored, 6–7.4 x 30μ. Spores white, elliptic, smooth, 3.4–3.8 x 6.5–9μ.

Except for the granular appearance they give to the bark, the plants are practically invisible when dry, as there is no contrast in color. Members of a cluster are flattened by pressure on the contact sides.

There is no doubt that this is Berkeley and Ravenel's species although our plants average smaller than the dimensions given by Burt (Ann. Mo. Bot. Gard. 1: 370. 1914), and the exposed hymenium when dry is shown only by a small part of the individuals. The surface, subgelatinous texture, spore and basidia size, and growth on alder are decisive characters. The species has been known heretofore only from the type collection on alder from South Carolina by Ravenel.

4995. On dead branches of alder, by Battle's Branch, February 6, 1922.

Phellodon delicatus (Schw.) Banker

Plate 48

Single or in more or less fused groups; cap up to 1 cm. broad, nearly plane or often quite irregular and lobed with depressed center. Surface

very soft and fibrous looking, whitish drab or darker brownish drab, sometimes with a faint tint of pink. Flesh brown, soft but tough, turning blackish when cut; odorless and tasteless.

Teeth very small and in large part rudimentary, in best condition terete or shaped like a shark's tooth, about one-third mm. or less long (rarely nearly 1 mm.), distant, nearly white, finally pale pinkish drab, the area between of the same color.

Stem very variable, up to 8 mm. long to the decurrent teeth, either very delicate and filiform or up to 1.2 mm. thick, expanding upward into the cap so that the latter is turbinate, sometimes so short as to consist of scarcely more than the thick, fertile, upper part; sterile part brown and usually darker than the cap; flesh tough and elastic, with a thin soft outer layer below.

Spores spherical, echinulate, 3.2–3.8μ. Basidia clavate, 4-spored, about 5.5μ thick, projecting well beyond the sterile cells. Cystidia none.

Some of the delicate little plants with filamentous stems look like long-handled pestles.

8280. Under deciduous leaves on Upper Laurel Hill, Nov. 4, 1927.

Marasmius nigripes (Schw.) Fr.

In this Journal (**43**: 142. 1927) we stated that this plant was not described by Kauffman. Since then we find that he includes it in his Agaricaceae of Michigan, p. 81, under the genus *Heliomyces*. He does not mention the blue color of the stem.

Marasmius nucicola McD.

Marasmius nucicola McDougall (Trans. Ill. St. Acad. Sci. **17**: 84) is the same as *Mycena luteo-pallens* Pk. (see this Journal **40**: 75. 1924).

PLATE 36

EICHLERIELLA PULVINATA. No. 5162

THE
JOHN CRERAR
LIBRARY

PLATE 37

DACRYOMITRA GLOSSOIDES. No. 4645

THE
JOHN CREAR
LIBRARY

THE CHAPEL HILL SPECIES OF THE GENUS PSALLIOTA

By W. C. Coker

Frontispiece and Plates 38–46 and 48

Key to the Species[1]

Spores vinaceous red, plants very small (up to 3 cm. broad).....*P. echinata*
Spores deep brown
Plants small (up to 4 cm. broad) and delicate; flesh about 1 mm. thick
P. diminutiva
Not as above
Color usually nearly pure white until maturity, turning deep brown; smooth and silky with fine fibers, but varying to brown with obvious scales; veil thin and ephemeral, not flocculent or warted below; gills with a bright pink stage; spores 4.8–6.5 x 7.4–11μ
P. campestris
Color light, whitish to creamy or yellow; scales none or inconspicous; gills never bright pink; veil warted or flocculent below; spores smaller
Flesh turning yellow when bruised; odor and taste distinct of peach kernels (bitter almonds)
Stem long, with an abrupt flattish bulb and with a distinct lightly stuffed central cylinder; underside of veil separating into soft patches; spores 3.5–4 x 5–7.2μ; growing in woods
P. abruptibulba
Stem shorter and thicker in proportion, usually swollen at and beneath the ground but with no distinct bulb and without a central cylinder; under side of veil fibrous flocculent; spores about 3.4–3.7 x 3.7–5μ; growing in cultivated or open places (gardens, paths, hedgerows, lawns, etc., less often in woods)
P. auricolor
Flesh not turning yellow when bruised (in our forms); no odor or taste of peach kernels
Cap white to buff (rarely brownish); flesh not changing color when bruised; spores 3.3–4 x 4.4–5.5μ.....*P. arvensis*
Cap vinaceous brown (avellaneous); flesh turning this color when bruised; spores 3.7–4.8 x 5.5–8μ....*P. arvensis* var. *hortensis*

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[1] Most authors describe the spores of this genus as purple-brown, but this is not correct for most species. The greater number we have seen have the spores true shades of brown with no tint of purple.

Color brown or reddish brown or pinkish brown, marked with small but conspicuous scales; not turning yellow; gills passing through a clear bright pink stage; veil thin, not separating below into patches; no odor or taste of peach kernels

Cap deep brown (cinnamon brown or snuff brown or Prout's brown); flesh not turning reddish when bruised; stem light brown; spores about 4.2 x 6.8μ.....*P. silvatica*

Cap with reddish brown scales over a pinkish base; flesh turning more or less reddish when cut; stem pinkish or steel gray; spores small, about 3.4 x 5.2μ.....*P. placomyces*

Psalliota echinata (Roth) Fr.
P. haematosperma (Bull.) Fr.
Inocybe echinata (Roth) Sacc.
Lepiota haematosperma (Bull.) Boud.
Pilosace eximia Pk.

Plates 38 and 48

Gregarious and often cespitose with 2–5 together; cap up to 2.1 cm. broad, campanulate with the margin bent inward until maturity, then expanded and decidedly umbonate, surface even, covered all over with a fine, removable meal which is deep sepia-brown, the surface below being a deep drab-brown, about the same color at all ages. Flesh about 2 mm. thick at the umbo and abruptly thinning to about 0.5 mm. beyond it, lightly tinted with the cap and gill colors; rather musky taste, almost odorless.

Gills rather close, none branched, about 2.5 mm. wide, suddenly rounded at the stem and free, a beautiful clear brick red color when young and until maturity and then a deeper sordid vinaceous brown, near Rood's brown or sorghum brown of Ridgway.

Veil delicate, covered below by friable particles, colored like the cap but lighter, breaking in tatters which mostly hang on the cap margin, sometimes forming a fugaceous partial ring about 5 mm. from the stem apex.

Stem not easily separating from the cap, tough and strong, about 2–3 cm. long, 2–3 mm. thick, equal, granular and striate above the veil, softly brown flocculent-farinose below; color deep brick-red which shows plainly under the thin, brown flocculence; flesh reddish, lightly stuffed or hollow at maturity.

Spores small, elliptic, smooth, a remarkable vinaceous red color, between vinaceous brown and deep Corinthian red of Ridgway, 2.5 x 4.5μ.

Boudier's figure (as *Lepiota haematosperma*) in his Icones mycologicae, is a beautiful and exact reproduction of our plant. Bulliard's plate 595, fig. 1, is also good. Ford and Sherrick (Journ. Phar. and Exp. Ther. **4**: 328. 1913) report this species as harmless, but that they really had this very rare species rather than *L. americana*, which has been confused with it, is doubtful.

Other synonyms given for this species are: *Agaricus fumosopurpureus* Lasch., *A. oxyosmus* Mont., *A. Hookeri* Kl., *A. haematophyllus* Berk. Beardslee writes me that it is also the same as *Pilosace eximia* Pk., which seems certain from the description. Of this remarkable little plant Fries truly says, "It is easily among the most remarkable and peculiar species." As may be seen from its synonyms, it is very difficult to place this little plant with certainty. Its whole appearance and particularly the red spores make it quite unique.

Bresadola under the name *Lepiota haematosperma* describes and figures a large plant (really *L. Badhami*), quite different from the true species, and two synonyms he gives there (*L. Badhami* and *L. americana*) do not apply. (See Lloyd, Myc. Notes, pp. 54 and 243.) Apparently the only other southern record is the first American one by Schweinitz from middle North Carolina (1822). It has been reported from Michigan by Kauffman and from New York by Peck (as *Pilosace eximia*). It occurs in cultivated grounds, at base of rotten stumps, or in greenhouses.

Illustrations: Boudier. Icon. Myc., pl. 12.
Bulliard. Herb. Fr., pl. 595, fig. 1.

In soil under shrubs (No. 2087, June) and on very rotten stump (No. 7055, Aug.).

Psalliota diminutiva Pk.

Plates 39 and 48

Cap 1.5–2.6 cm. broad, nearly plane, delicately fibrillose and with or without minute squamules, disk rosy brown, rather abruptly fading outward to whitish on the margin. Flesh very thin (1 mm.), white.

Gills pallid then through pink to dark brown, free, close, ventricose, 4 mm. wide, margins faintly eroded.

Stem white then easily becoming brownish through age or handling, 3–3.5 cm. long, 1.5–3 mm. thick, inherently silky.

Veil delicate, forming a small ring about 5 mm. from the cap base, somewhat bulbous, center stuffed.

Spores dark brown, short-elliptic, smooth, 2.6–3.4 x 3.8–5μ, with a small distinct oil drop. Basidia 4-spored.

The gills leave a greenish stain on white paper.

This seems to be scarcely more than a color form of *P. comtula* Fr., which differs in the pale, whitish cap. Both forms occur rather commonly in the United States and efforts to separate them seem to have been unsuccessful. Both occur in the mountains of North Carolina and our No. 5518 is the *comtula* form, with creamy white cap, staining brownish where bruised. The gill margins in this particular plant as well as in the other form are without specialized cells and the basidia and spores are identical in both. Both forms when pressed against white paper stain it bluish or greenish. However there is nothing very distinctive about this, as other species, e.g. the ordinary mushroom of commercial beds, are more or less inclined to do this.

Illustrations: Kauffman. Agaricaceae of Michigan, pl. 50.
Peck. Ann. Rept. N. Y. St. Mus. **54**: pl. 74, figs. 1–8.

North Carolina. Chapel Hill. In woods and on a lawn, Sept. Nos. 438 and 1674.
Blowing Rock. Couch, coll. (U. N. C. Herb., No. 5518). Spores 2.8–3.6 x 4.2–5.5μ.
Haywood County. In mountain woods, Aug. 1926. Coker and party, colls. Nos. 8043 and 8144.

Psalliota campestris L.

Plates 40 and 48

Plants rather small, usually about 6.5–7.5 cm. broad (rarely up to 9.5 cm.), spherical at first, then convex or nearly plane, as a rule nearly pure white up to maturity, changing to deep browns and finally blackish when quite old, smooth and silky with fine fibers. Some plants are brownish even when young and in these the surface is often more scaly. These plants grow in identical places with the white forms and there are all gradations between the two. Flesh white and firm, unchanging when cut; taste very pleasant and nutty.

Gills 6–8 mm. wide, free, close and of unequal lengths, white when very young, turning bright pink, then brown and blackish.

Stem short, 5–7 cm. long, not bulbous but nearly cylindrical, usually tapering slightly downward; surface smooth, silky and white, flesh solid but softer in the center.

Veil silky and ephemeral, conspicuous when young, collapsing and perishing in age. As the cap expands the veil breaks near the middle and the peripheral part remains attached as a beautiful fimbriated fringe to the cap margin. The remaining part forms a distinct ring which is attached about 1 cm. below the gills.

Spores deep brown in heavy prints, a shade deeper than raw umber of Ridgway, a little lighter than in any other of our Chapel Hill species of *Psalliota* (except *P. arvensis* var. *hortensis*), 5.5–6.5 x 7.4–11μ.

This is the well known "meadow mushroom" or "pink gill," one of the most agreeable and generally popular of all edible fungi. Fortunately it is one of our most abundant species and it is deplorable that so much of this appetizing food is allowed to waste through ignorance. It is abundant in lawns, meadows, orchards, and along paths from June to October, being particularly fond of open grassy places that are fertilized with animal manures. It often forms complete or partial fairy rings from the circular habit of its mycelial growth. It is about the shape, size and general appearance of *Stropharia bilamellata*, which grows in similar situations. Fortunately this species is not harmful so that no danger will result if it is gathered by mistake with the meadow mushroom. It is, however, far inferior to the meadow mushroom in its esculent qualities.

Illustrations: Demelius. Verhandl. der k. k. Zool.-bot. Ges. **63**: pl. 7, fig. 30. 1913.
Gibson. Our Edible Toadstools and Mushrooms, pl. 5.
Krieger. Nat. Geog. Mag. **37**: pl. 1. 1920.
Murrill. Mycologia **1**: pl. 3. 1909.
Palmer. Mushrooms of America, pl. 1.

In grass and open places, summer and fall. Nos. 434, 1104 (spores 6.2–7.4 x 7.4–9μ), 1240.

Psalliota abruptibulba Pk.
Agaricus abruptus Pk.

Frontispiece and Plates 41, 42 and 48

Cap up to 5.5 cm. broad, smooth, or faintly marked with small inherent inconspicuous scales, silky, nearly white or cream color when

young, becoming somewhat darker with light brownish, buff, drab or yellowish tints, evenly colored or darker in center; in age the margin becoming a deep brown (Vandyke brown, Ridgway). In unexpanded plants the margin is puckered and fluted just as in *P. auricolor*. Flesh firm, brittle, about 5 mm. thick at stem, white but turning yellowish when bruised; taste mildly but distinctly like bitter almonds.

Gills free, slow to color, turning a light grayish pink about the time the veil breaks and then a dull brownish pink and then dark. In every way they act exactly as in *P. auricolor* and *P. arvensis* and decidedly different from *P. placomyces* in which the gills are bright pink when young and still quite pink at maturity.

Veil thick, persistent, attached about 0.5–1 cm. from the top, the lower part composed of soft flocculent material which cracks into areas as the plant matures, exactly as in *P. arvensis*. The dense unbroken upper layer of the veil begins to turn buff even before it breaks from the cap margin and this color deepens to deep brown buff at maturity. The lower flocculent patches usually partake of this change more slowly and remain lighter.

Stem slender, long, about 6–9 cm. long and 1.1 cm. thick, equal above the decided, abrupt bulb which is shallow and flattened below and attached to one or more decided rhizomorphs; surface colored like the cap at first and may remain so, but often turning a deep drab-brown or brownish yellow on maturing; surface below the veil covered with more or less conspicuous white flocculent particles which are largest near the base and most noticeable in youth, easily collapsing; surface above the veil silky shining. In the center is a sharply defined, small, lightly stuffed cylinder.

Spores (of No. 1120) very deep brown (Prout's brown, Ridgway), elliptic, 3.5–3.8 x 5–7.2μ.

The taste is fine and nutty, with a distinct flavor of bitter almonds, almost exactly like that of *P. auricolor* but not so strong.

This is considered the same as European *silvicola* by Murrill (Mycologia **6**: pl. 139; **14**: 209), and the plant is illustrated by Atkinson under that name (Mushrooms, figs. 19, 20). Peck first named this *A. abruptus* but as this name was antedated later changed it to *A. abruptibulbus* (see N. Y. State Mus. Bull. **94**: 35. 1905). The caps of this species are almost exactly like the smooth lighter colored forms of *P. arvensis*, and the veil is much alike in both (attached further from the cap in *arvensis*), but the abrupt bulb, prominent granular flocculence on the stem and the peach kernel flavor of *P. abruptibulba* distinguish it at

once from *P. arvensis*. The former species can also be distinguished from *P. auricolor* by the abrupt bulb which is not covered over thickly with dirt, the very different veil, the absence of the clear yellow color of margin and stem fibers when young, and by the larger spores. In *P. auricolor* there is no abrupt bulb and the slightly enlarged part which is more deeply buried in the ground is strongly covered with earth when removed.

Usually in woods, rarely open places, summer and fall. Nos. 219, 220 (spores 3–3.5 x 4.2–5.2μ), 706, 754, 1111, 1120, 1247 (spores 3.5–4 x 4.8–6.8μ), 1262, 1699, 1700, 1923, 2264.
Haywood County. (U. N. C. Herb. No. 8065).

Psalliota auricolor (Krieger) n. comb.
Agaricus auriculor Krieger.
Agaricus amygdalinus Curtis, nomen nudum

Frontispiece and Plates 43 and 48

This is the plant treated by Dr. M. A. Curtis as *A. amygdalinus* in his Catalogue of the Plants of North Carolina (1867), in his letters, manuscripts, etc. As no description in print ever accompanied the name, Mr. Krieger's new name will be the authentic one. The species is not at all uncommon in the south, but it has never been understood by northern botanists.

In Curtis' herbarium there are five plants of this species. The oldest (No. 1243) was collected at Society Hill, S. C., in 1836, and if the species had ever been properly published, this would be the type. He first labelled it *A. arvensis* var. and later changed it to *A. amygdalinus*. All the other specimens of *amygdalinus* in Curtis' herbarium were first labelled *A. fabaceus* Berk. and later corrected to *A. amygdalinus*. In his original field notes which he sent to Berkeley under number 1243 Curtis gives a description of the plant which shows clearly what he understood by *A. amygdalinus*. This description is as follows:

1243. (*Ag. arvensis*, var.) Cap convex, smooth, white, diluted with brownish or yellowish. Flesh in the center 2–3 lines thick. Lam: white, becoming pink, then dark fuscous, unequal, free, rounded at the base. Spores ferruginous. Stipe solid, thick, bulbous at the base, easily detached from the pileus. June. Sandy fields. (The smallest specimen had the cap bright straw-color). When broken has a strong odor of peach kernels. Taste similar, but not strong. I do not find

this odor noticed in the species by any author in my possession. It is the favourite of mycophagists in this country.

In an unpublished manuscript by Dr. Curtis on Edible Mushrooms of North America, which his family has kindly allowed me to examine, Dr. Curtis gives another description of the "peach kernel mushroom" as follows:

This is fortunately a species that can be determined without mistake, and is equal in flavor to the best. Indeed when cooked it can not be distinguished from the Pink Gill. [*A. campestris*]. It resembles that very much in appearance and is easily mistaken for it; but its strong odor and taste of peach kernels or bitter almonds will at once determine it from all others. When cooked this peculiar flavor is dissipated entirely. To those who are fond of mushrooms in a crude state, this will be superior to all others, leaving an exceedingly pleasant after-taste on the palate.

This does not affect grassy land so much as the preceding species [*A. campestris*], but is most common in cultivated manured grounds as in gardens, also stables, and the borders of rich woods. It is from two to eight inches broad in the cap, according to the richness and mellowness of the soil, with a stem from two to six inches high gradually enlarged to the base. The color is whitish or yellowish-white, in smaller specimens. In larger ones it is somewhat rusty with small fibrous patches of the skin which partially detach from the cap in nearly concentric circles. The gills are white before becoming flesh or pink-colored, then changing to brown and black. The veil is much thicker and heavier than in the other, detaching itself from the margin of the cap and falling down upon the stem, where it hangs like a collar for a day or two.

Dr. Farlow, in discussing the identity of *amygdalinus*, *fabaceus* Berk. and *subrufescens* Pk. (Proc. Bost. Soc. Nat. Hist. **26:** 356. 1894), is inclined to think all these three species the same. As. Dr. Farlow was not familiar with *amygdalinus* in its fresh condition he was not aware of the striking peculiarities of the plant. It is certainly not the same as *subrufescens*, and is, I think, with equal certainty not *fabaceus*. The former clearly differs in its long, slender, hollow stem, absence of yellow change when bruised and larger spores (about 4–5 x 6–7.5μ). It is much more like what we are calling *abruptibulba* Pk., but differs from that in its unchanging flesh and much darker cap. *Agaricus fabaceus* is a large, long-stemmed plant, which by the descriptions (Berkeley, Morgan) cannot be distinguished from *abruptibulba*. The type specimens at Kew are up to 10 cm. broad and with stems up to 11 cm. long. They do not look like *amygdalinus* and the spores are too large (3.5–4 x 6–7μ, according to Miss Wakefield. See Murrill, Mycologia **14:** 221. 1922).

As Mr. Krieger has seen but one small plant and that with a pointed base, (a less common form) it is desirable that a fuller description be available. Curtis does not mention the change to yellow when bruised and Krieger does not note the peach kernel flavor and odor. Such matters are often overlooked in descriptions. Our description follows:

Plant solitary or scatteringly gregarious, very rarely cespitose, about the size of the meadow mushroom, rarely over 5 cm. wide, irregular, the margin strongly crumpled in youth; unexpanded plants tinted or streaked with shades of light to deeper yellow, the color usually most intense in the center or on margin and the lower side of the veil and usually the stem base also yellow tinted. As the plant matures the yellow color usually fades on the cap and is replaced by shades of pinkish buff and cinnamon buff (Ridgway). The yellow remains more permanently on the veil and the stem below, but in old age the cap margin becomes very dark vinaceous umber—nearly black finally. Surface fibrous and usually furnished with small inconspicuous scales. Flesh white, usually turning light or deep orange or orange brown (rarely pinkish brown) when cut, firm, with a very decided peach-kernel odor and flavor. Rubbed surfaces also turn yellow.

Gills moderately close, free, widest near the margin where they are 4–5 mm. deep; white when young (only faintly pinkish when the veil breaks), then a grayish pink (light russet vinaceous, Ridgway), and finally a deep sooty brown.

Veil delicate and thin, but densely flocculent on the under surface, part remaining pendent on the margin and part forming a delicate skirt which does not stand out straight but hangs down about 1 cm. from the top and is connected with the stem by flocculent fibers that extend on down to the stem base.

Stem usually short, and thickened downward, about 4–5 cm. long sometimes with a slight bulb and 5–7 mm. thick in center; base deeply embedded in the ground, so that the ring is often only a little above the ground and on the buried portion the earth strongly adheres; surface above the ring smooth and shining, flocculent below. Flesh of stem solid, firm (no central cylinder), turning orange when cut, often badly riddled by grubs.

Spores (of No. 1088) deep smoky brown, considerably darker than in *A. campestris*, but not so dark as in *A. arvense*, short-elliptic, 3.4–3.7 x 4.2–5.2μ.

It is true, as Curtis notes above, that this species is most plentiful in open places, manured grounds, etc., but it is not rare in woods, and we have even found it in moss near water in dense wood. We have many collections of the plant made during the last fourteen years and I have often eaten it. Curtis does not exaggerate its fine quality. The pink color of the gills is never so lively as in *P. campestris* and is later to

appear. In this respect the plant agrees with *P. arvensis* and several other species. Occasionally a plant is found that is pure white until it is discolored by handling. Under the caption *Agaricus amygdalinus* Curtis, Ford and Sherrick (Jour. Phar. & Ther. **4**: 326. 1913) have the following to say:

"This fungus which is regarded by some authors (Farlow) as identical with *Agaricus fabaceus* Berk. has occasionally caused unpleasant symptoms when ingested, but no cases of serious poisoning have been traced to it. Specimens were sent us for examination by Dr. Trelease, Director of the Missouri Botanical Station, St. Louis. Their extracts were quite without effect upon blood corpuscles, had no action upon the frog's heart and were not poisonous to either rabbits or guinea pigs on subcutaneous inoculation."

I do not know whether the plant they studied was *A. amygdalinus* or not.

Illustrations: Krieger. Mycologia **19**: pl. 36, fig. 2. 1927.

North Carolina. Chapel Hill. Numerous collections.
South Carolina. Hartsville. Coker, coll. (U. N. C. Herb.).
Society Hill. Four collections in Curtis Herbarium.
Santee Canal. Ravenel, coll. (Curtis Herb.).

Psalliota arvensis Schaeff.

Plates 44 and 48

Cap 7–16.5 cm. wide, silky white when young, almost exactly like the meadow mushroom and *P. abruptibulba*, at maturity usually becoming a light buff or cream in part, other parts remaining nearly white; margin inclined to be irregular and more or less crumpled as in *P. auricolor;* surface remaining smooth and shining as a rule, not cracking into scales, but we have found plants with distinct, reddish brown scales (1096, 1102). Flesh about 8–9 mm. thick in the center, white, creamy in age, taste and odor nearly like that of the meadow mushroom.

Gills close, firm, broadest (about 7 mm.) in middle, turning from white to grayish pink and then to drab or a deep blackish brown, the color seeming to depend a good deal on the weather. The pink color is duller and much later in appearing than in the meadow mushroom, not being evident when the veil breaks.

Veil rather thick and firm, double, the soft underside cracking as it

expands, the silky smooth upper layer remaining intact; ring persistent, hanging about 1.5–2.5 cm. from the top; veil white when young but usually becoming a fine buff color at maturity, the lower flocculent part being less deeply colored, in this respect also resembling *P. abruptibulba*.

Stem rather long and stout, equal or larger below but never with an abrupt bulb, usually about 6–7 cm. long and about 1.2 cm. thick; surface very smooth and silky shining all over or pruinose toward the base, white at first, then showing areas of buff and tan; center with a small, clearly defined, lightly stuffed cylinder as in *P. abruptibulba*, but often eaten hollow by grubs.

Spores (of No. 3287) very deep brownish black (between raw umber and black), oval, 3.3–4 x 4.4–5.5μ.

This species most resembles the meadow mushroom in color but is larger, the veil is thicker and more persistent, and the spores are darker and much smaller. It grows in open places and in the edges of fields and woods near trees and is often found with the meadow mushroom: summer and fall.

In drying all our collections of this plant excreted quantities of white salty granules. This is usually the case also with the meadow mushroom.

Illustrations: Krieger. Nat. Geog. Mag. **37:** pl. 1. 1920.

Nos. 1093, 1096 (spores 3.7 x 4.6–5.5μ), 1103 (spores 3.7 x 3.7–4.6μ), 1121, 1283, 2037, 3287.

Psalliota arvensis var. **hortensis** (Cooke) W. G. Smith

Plate 48

We are referring to this name a plant that we occasionally find around manure piles. It has exactly the appearance of one of the common forms of market mushrooms grown in commercial beds. Its relationship to *arvensis* rather than *campestris* is shown by the thick, warted veil, heavy body and dull pink gills.

Cap up to 17 cm., vinaceous brown (avellaneous), at times with yellow stains, finely scaly. Flesh avellaneous or becoming so when cut. Stem short, rather abruptly bulbous and with a soft central cylinder; flocculent below the veil. Veil as in *P. arvensis*. Spores sepia of Ridgway, 3.7–4.8 x 5.5–7.4μ.

Around old manure piles, summer and fall. Nos. 1253, 2065, 3586.

Psalliota silvatica Fr.

Frontispiece and Plates 45 and 48

Cap up to 11 cm. broad, usually 4 to 6, typically broad. Cap slightly convex, somewhat umbonate with a slight depression around the umbo when mature, completely covered with minute scales, or the superficial layer scarcely separating into scales, deep reddish brown in the center, about cinnamon brown or snuff brown or in the darkest ones Prout's brown of Ridgway, shading toward the margin to lighter shades of the same color. Plants of No. 1265 that had expanded in a 24 hour rain were remarkable, blotched with large areas of deep rose color. Flesh rather thin, delicate, pure white, unchanging. Odor slight, taste pleasant, about as in *A. campestris*, no flavor of almonds.

Gills 3.5 to 5 cm. wide, thin, close, many short, none branched, white at first and remaining so usually until after the veil breaks, occasionally pinkish sooner, becoming a deep clear pink at full expansion, then rapidly becoming smoky pink and finally deep smoky brown.

Veil white above, color of edge of cap or paler below, delicately silky fibrous below, very thin but strong and persistent, not double; attached from 1 to 2 cm. from the top.

Stem 4.5 to 6.5 cm. long, about 5 or 6 mm. thick in center, tapering upward, nearly white at top, color of cap (but lighter) below, nearly white below ground, usually finely fibrous tomentose like the veil from the ring down; very smooth and shining above. It descends a centimeter in the ground and is distinctly bulbous, the bulb rounded below and sometimes rather abrupt, firmly attached to the ground by one or a few distinct white mycelial strands. A small central channel in the stem tends to be hollow in age.

Spores (of No. 1265) deep brown, elliptical, 3.4–5 x 5–7.6μ, most about 4.2 x 6.8μ.

Distinguished from all others by the reddish brown (snuff brown of Ridgway) color of the cap.

In grass on lawns and under the edge of a wood shed (probably on rotten wood), July to September. Nos. 462 (spores about 4.6 x 7.4μ), 1087 (spores 3.7 x 6.5–7.4μ), 1265, 1685, 1686, 2422, 3510.

South Carolina. Hartsville, Coker, coll. (U. N. C. Herb.)

Psalliota placomyces Pk.

Plates 46 and 48

Cap up to 10 cm. broad, hemispheric then plane, ground color pinkish with reddish brown cuticle which breaks into scales except in the center. Flesh 2–6 mm. thick near the stem, firm, white, turning more or less reddish when cut. Taste very pleasant and nutty, but not with peach kernel flavor.

Gills free, fairly close, 5 mm. deep in center, beginning to turn pinkish when the veil breaks and becoming a clear pink when freshly expanded, not the faint grayish and brownish pink of *abruptibulba* and *arvensis* and *auricolor*. In age becoming deep blackish brown.

Veil rather thick, the lower part finely flocculent and a light creamy buff, not separating into patches, the upper side membranous and white. In age the veil does not become darker, thus differing decidedly from *abruptibulba*, *arvensis* and *silvatica*.

Stem 8 to 10 cm. long, 7 to 12 mm. thick at top, enlarging downwards and expanding below into a decided bulb; when young nearly white above and light grayish brown below, in age the top becoming a dark steel gray which is lighter below; surface somewhat fibrous, but not flocculent as in *abruptibulba* and *silvatica*. Flesh of stem with a central cylinder which is stuffed or hollow.

Spores deep brown (Prout's brown, Ridgway), elliptic, smooth, 3.4 x 4.5–6.5μ.

I can refer these only to *placomyces* although as is often the case our southern plants are not in complete agreement with the northern ones. Peck's types which I have compared look like our plants and the spores are the same. In *placomyces* the veil is said by Kauffman to separate below into patches and nothing is said of any change to reddish when the flesh is cut. However, Peck does not mention the double veil and his figures show a thin simple one. One of Atkinson's photographs shows a flocculent under surface to the veil as in our plants. Others show the condition described by Kauffman. In *P. haemorrhodaria* the flesh turns pink or red when cut, but in color and form our plants look much more like the former species. The figures of *placomyces* by Atkinson and by Hard could scarcely be distinguished from our plants.

Illustrations: Patterson and Charles. U. S. Dept. Agric. Bull. 175: pl. 25, fig. 1. 1915.

In woods in summer and fall. Nos. 221, 223, 507, 738, 1016, 1256, 1266 (spores 3.4 x 4.2–6μ), 1922, 5157 (spores 3.5 x 5.5–7μ).

PLATE 47

Figs. 1–6. Sirobasidium sanguineum. No. 4728. Basidia, spores and secondary spores produced by the sprouting of the basidiospores.
Fig. 7. Exidia minutissima. No. 4431. Basidium and sprouting spore.
Figs. 8–12. Exidia candida. Idaho (Weir Herb.). Hyphae with unusual connections, basidia and spores.
Figs. 13–21. Eichleriella pulvinata. No. 5162. Fig. 13 shows section of hymenium; fig. 16, tip of paraphysis; fig. 17, bit of hypha from flesh.
Figs. 1–7, 14–17, 19, 20 × 810; figs. 8–11 × 1013; figs. 12, 21 × 1620; fig. 13 × 18; fig. 18 × 503

PLATE 48

Figs. 1, 2. Arrhytidia enata. No. 4989.
Figs. 3, 4. Dacryomitra glossoides. No. 5396.
Figs. 5, 6. Cyphella minutissima. No. 4917.
Figs. 7, 8. Cyphella subgelatinosa. No. 4995.
Figs. 9, 10, 11. Phellodon delicatus. No. 8280. Figs. 9 and 10, basidia and spores; fig. 11, pen drawing of plants, natural size.
Fig. 12. Psalliota echinata. No. 2087.
Fig. 13. Psalliota diminutiva. No. 438.
Fig. 14. Psalliota campestris. No. 1104.
Fig. 15. Psalliota abruptibulba. No. 1120.
Fig. 16. Psalliota auricolor. No. 1088.
Fig. 17. Psalliota arvensis. No. 1103.
Fig. 18. Psalliota arvensis var. hortensis. No. 2065.
Fig. 19. Psalliota silvatica. No. 1265.
Fig. 20. Psalliota placomyces. Type.
Fig. 21. Psalliota placomyces. No. 1266.
Figs. 1, 3, 4, 7, 9 × 810; fig. 6 × 1013; fig. 11, nat. size; others × 1620

PSALLIOTA ECHINATA. No. 2087

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PLATE 39

PSALLIOTA DIMINUTIVA. No. 438

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PLATE 40

PSALLIOTA CAMPESTRIS. No. 434

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PLATE 41

PSALLIOTA ABRUPTIBULBA. No. 1111

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PLATE 42

PSALLIOTA ABRUPTIBULBA. No. 1923

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PSALLIOTA AURICOLOR. No. 1088

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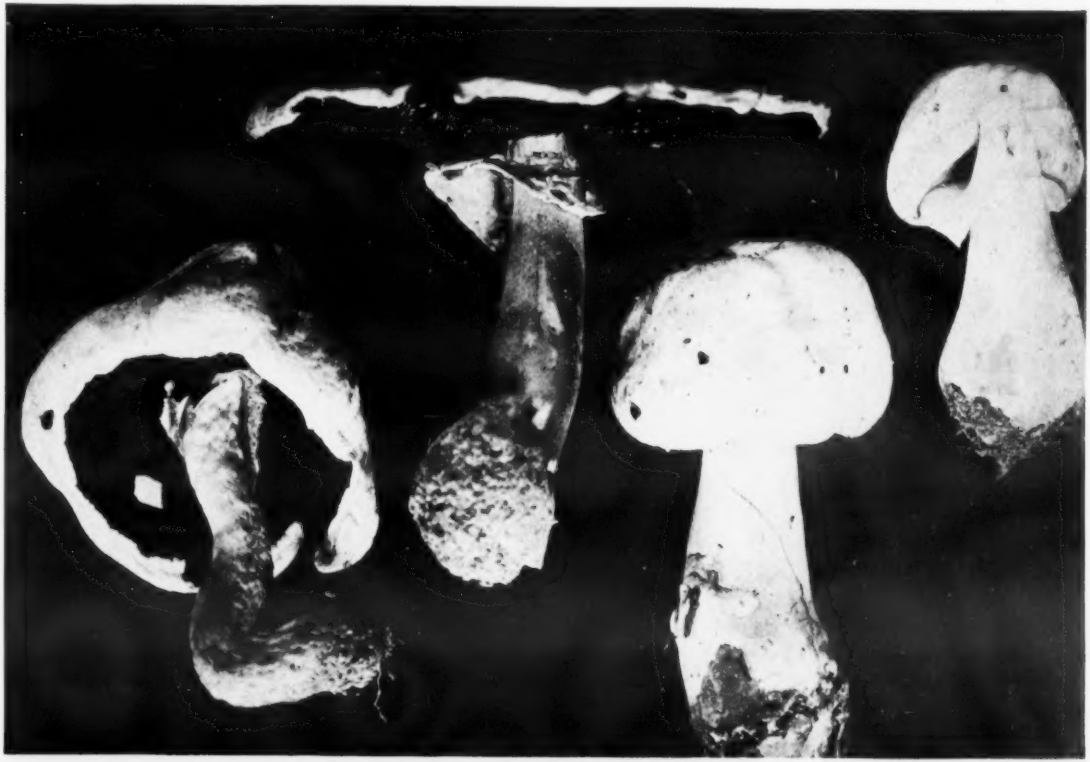

PSALLIOTA ARVENSIS. No. 1093

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PLATE 45

PSALLIOTA SILVATICA. No. 1685

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PLATE 46

PSALLIOTA PLACOMYCES. No. 507

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PLATE 47

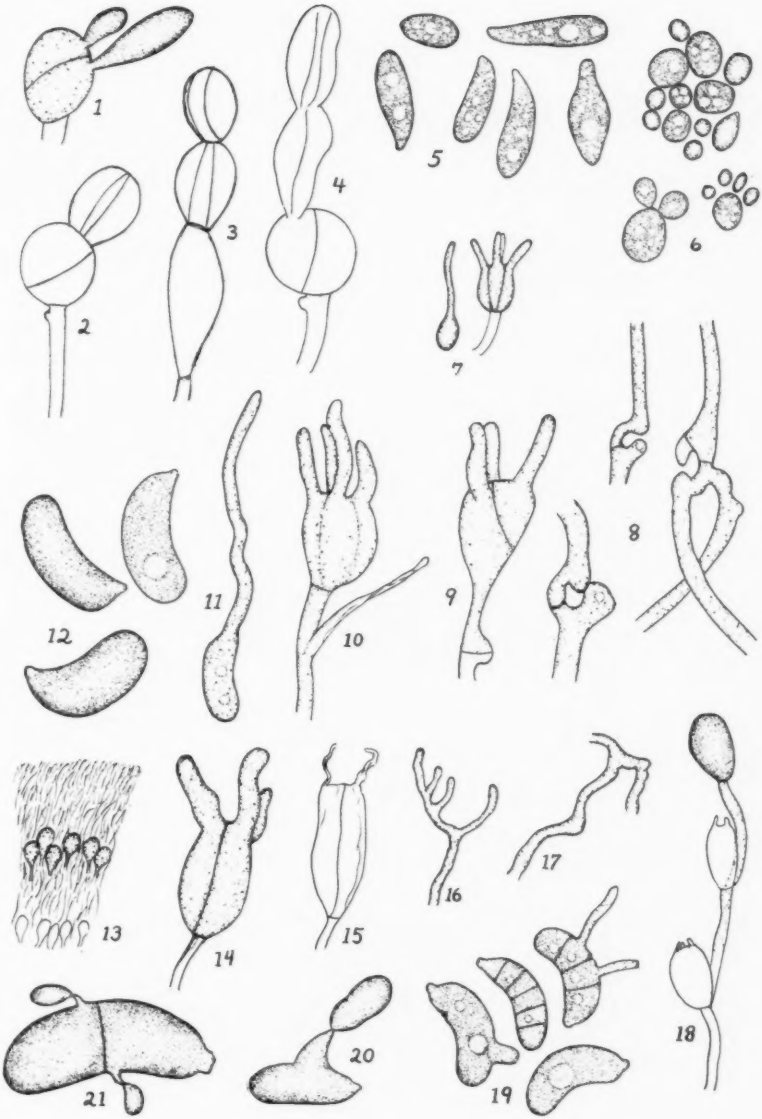

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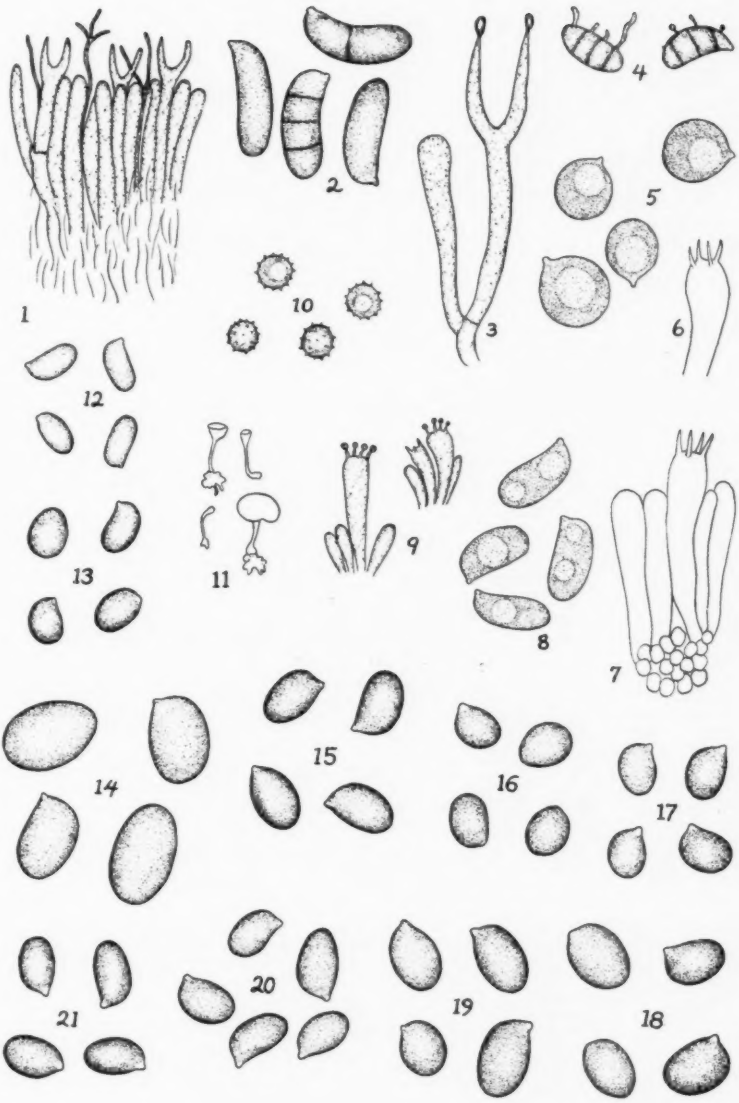
PLATE 48



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